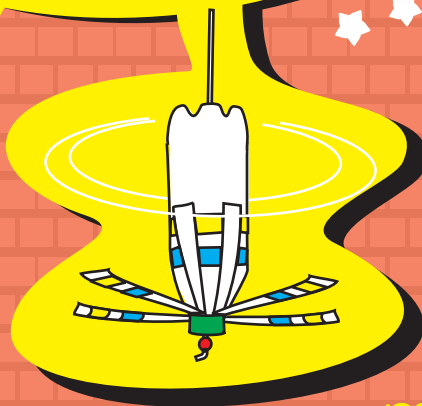
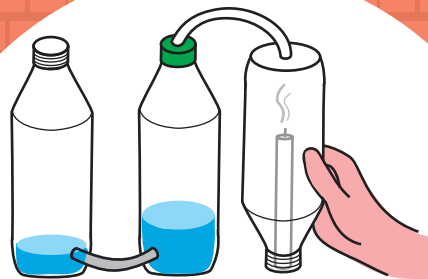


# Sci-fun



Arvind Gupta

Illustrations by Reshma Barve



**ARVIND GUPTA** graduated from the Indian Institute of Technology, Kanpur (1975) with a degree in Electrical Engineering. He has written 20 books on science activities, translated 150 books into Hindi and presented 125 films on science activities on *Doordarshan*. His first book *Matchstick Models & Other Science Experiments* was translated into 12 Indian languages and sold over half a million copies. He has received several honours, including the inaugural *National Award for Science Popularization amongst Children* (1988), *Distinguished Alumnus Award of IIT, Kanpur* (2000), *Indira Gandhi Award for Science Popularization* (2008) and the *Third World Academy of Science Award* (2010) for making science interesting for children.

Currently he works at IUCAA's Children's Science Centre, Pune, and shares his passion for books and toys through his popular website <http://arvindguptatoys.com>

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# SCI-FUN

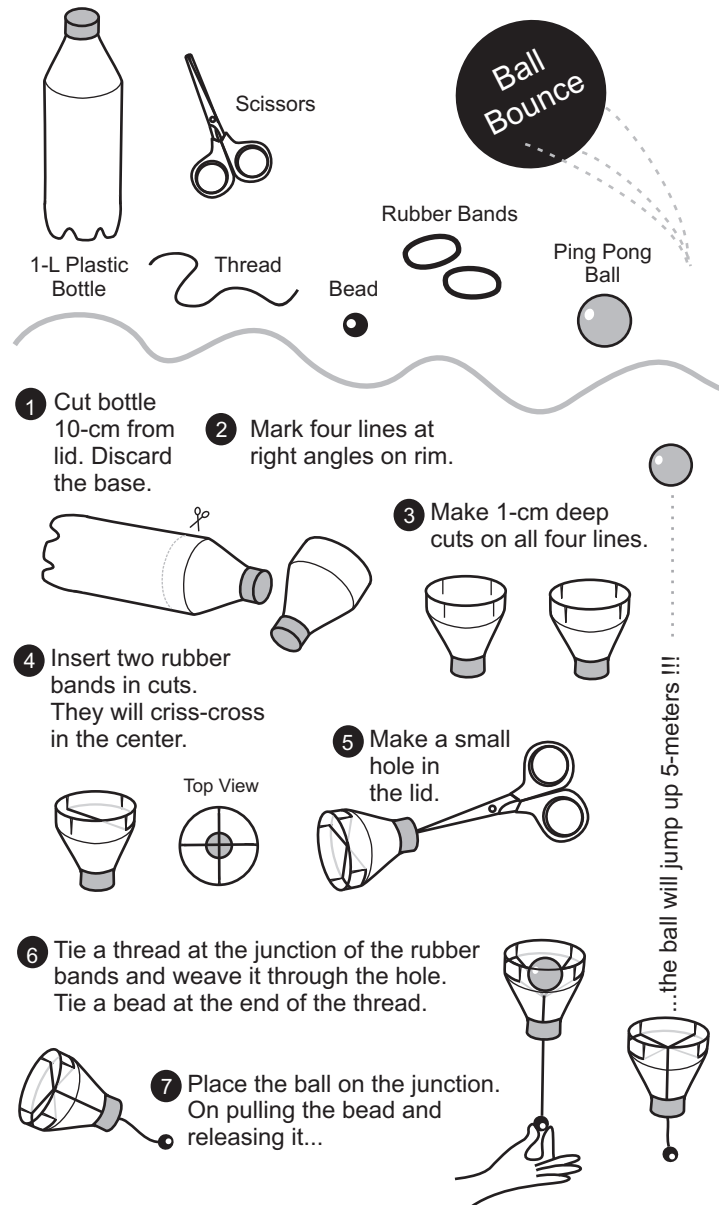
**ARVIND GUPTA**  
ILLUSTRATIONS BY RESHMA BARVE

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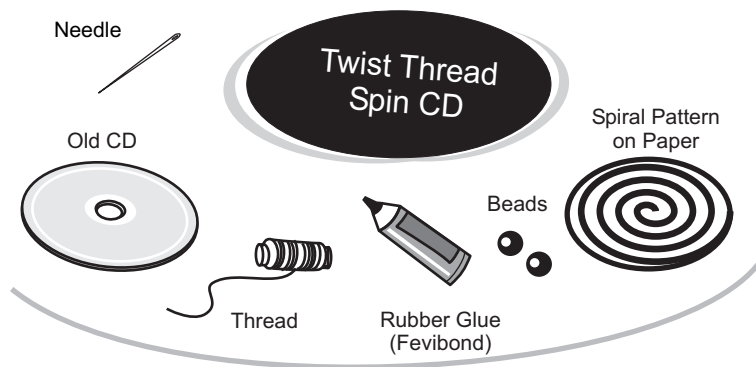
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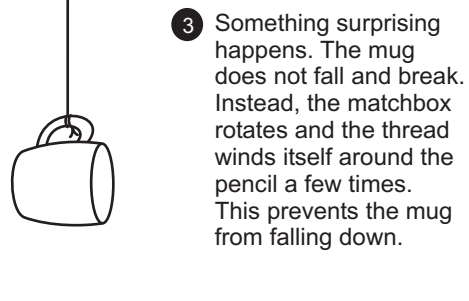
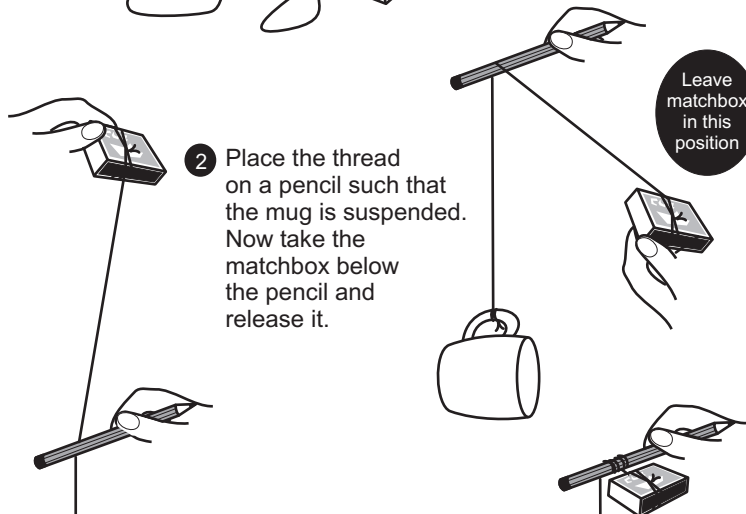
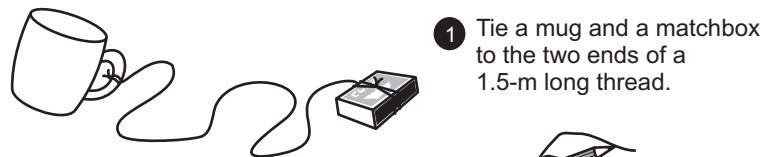
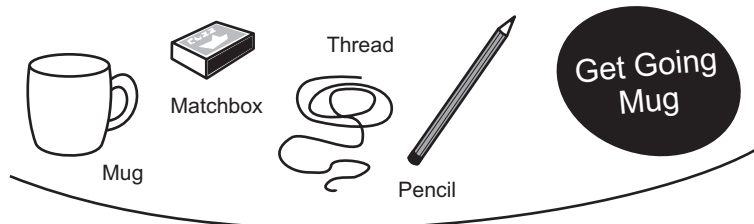


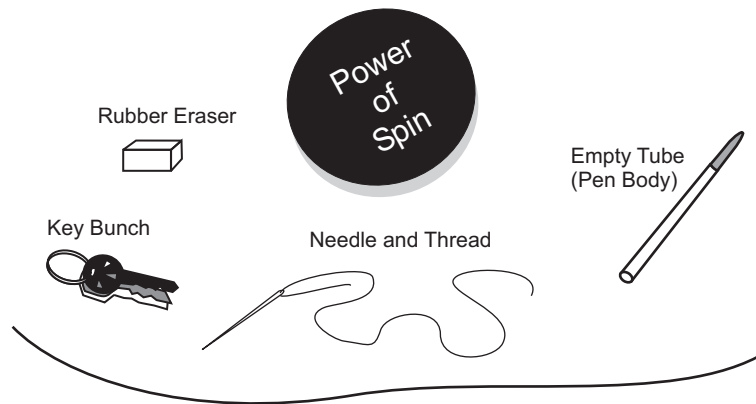






- 1 Make two neat holes near the central hole of an old CD using a hot needle.
  - 2 Stick a spiral pattern on the CD with glue.
  - 3 Weave a 60-cm long thread through the holes. Tie beads on ends.
  - 4 Hang the CD with one hand as shown.
  - 5 On pulling the beads away the CD will spin very fast and the spinning spiral will look glorious!
- Give CD a twirl with the other hand.
- Wind and unwind repeatedly.
- CD will spin, twisting the thread.

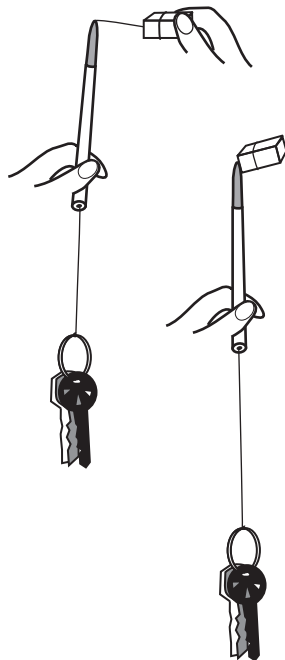




- 1 Weave a 80-cm long thread through an old pen body.

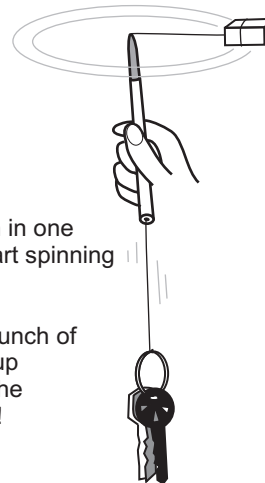


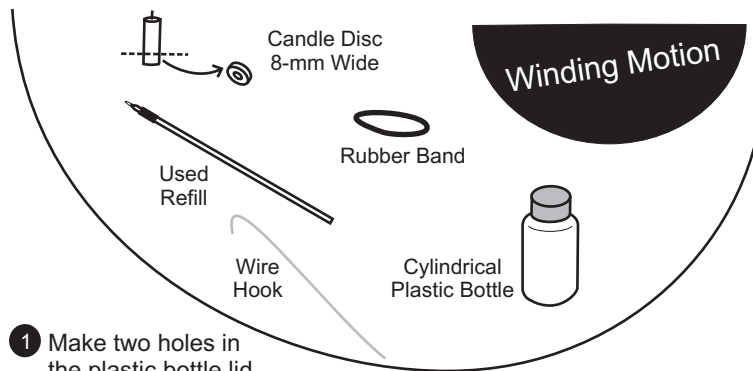
- 2 Tie a small weight (eraser) on top and a heavy weight (keys) below.



- 3 Hold the pen in one hand and start spinning the eraser.

The heavy bunch of keys will lift up because of the force of spin!

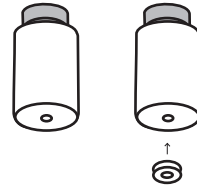




- 1 Make two holes in the plastic bottle lid.



- 2 Make a hole in the base of the bottle. Stick a small piece of candle on the bottle hole.



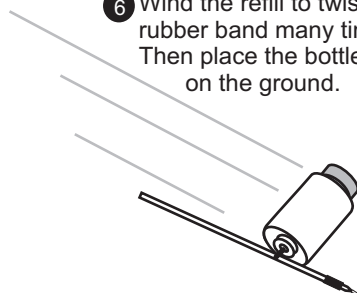
- 3 Cut a large rubber band and weave it through the holes of the lid. Tie a knot.

- 4 Screw lid on the bottle. Pull the rubber band through the base hole with a wire hook.

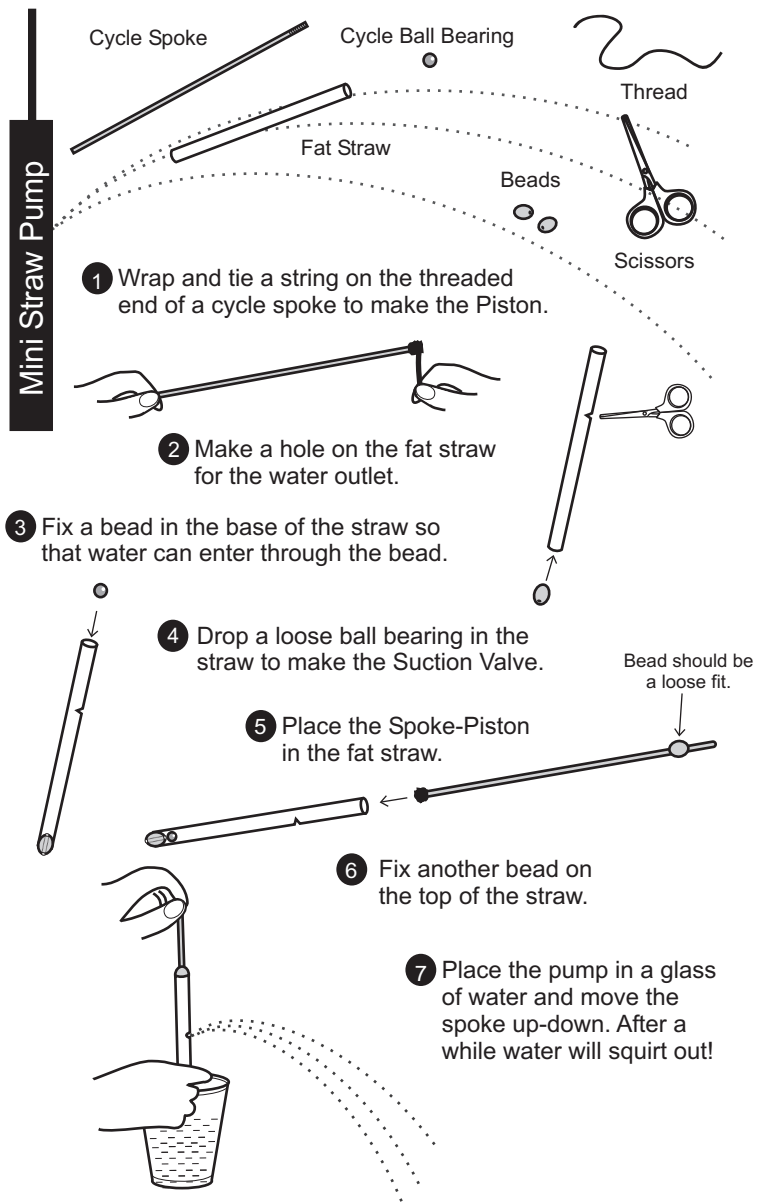


- 5 Place an old ball pen refill in the rubber band. The candle piece will help in reducing friction.

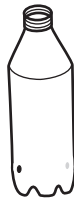
- 6 Wind the refill to twist the rubber band many times. Then place the bottle on the ground.



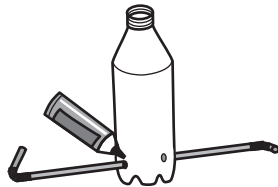
The rubber band will unwind and the bottle will move forward!



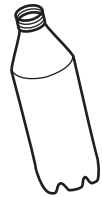
- 1 Make two holes on opposite ends of a plastic bottle near its base.



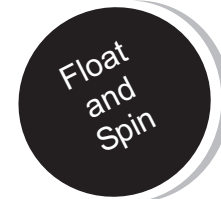
- 2 Insert two bent straws and seal the joints with glue.



Styrofoam Plate



1-L Plastic Bottle



Two Bent Straws



Scissors



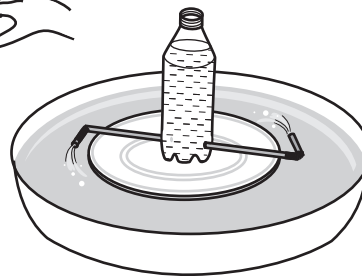
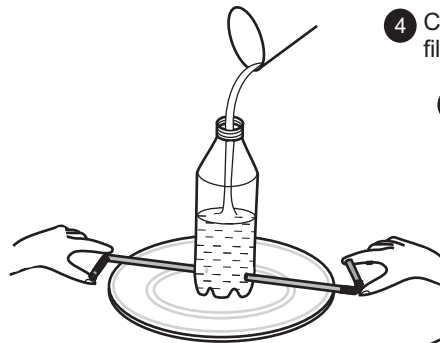
Rubber Glue (Fevibond)

- 3 Stick the bottle right in the middle of a Styrofoam plate - which will act like a boat.

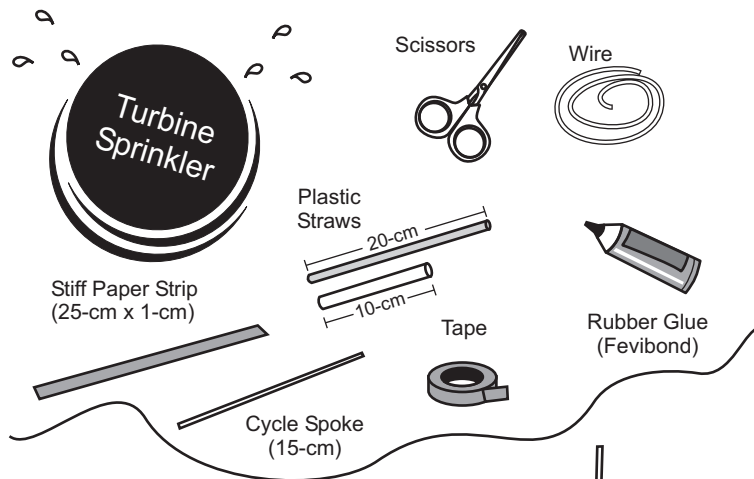
- 4 Close both straw ends and fill the bottle with water.

- 5 Gently place the plate with the bottle in a tub of water.

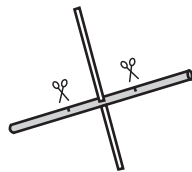
- 6 On opening the straw ends...



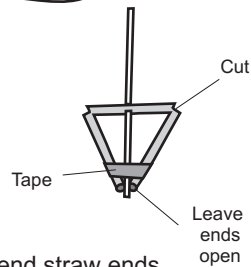
...the model will start spinning!  
This action-reaction toy is based on Newton's Third Law of Motion!



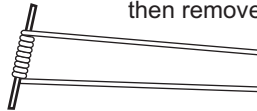
- 1 Poke a cycle spoke in the middle of a straw. Make two half cuts 3-cm each way from the middle.



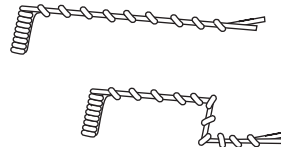
- 2 Bend straw ends in a triangle and tape them to make a sprinkler.



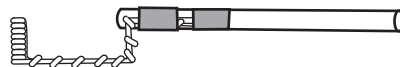
- 3 Wind a wire spring on a refill. then remove the spring.



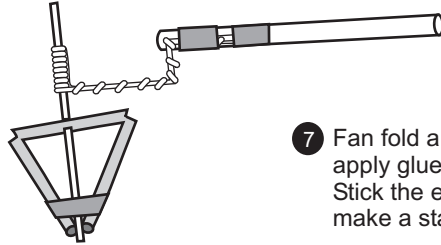
- 4 Twist the ends of the spring and bend them as shown.



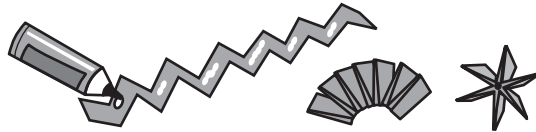
- 5 Attach the twisted arm of the spring to the straw with tape.



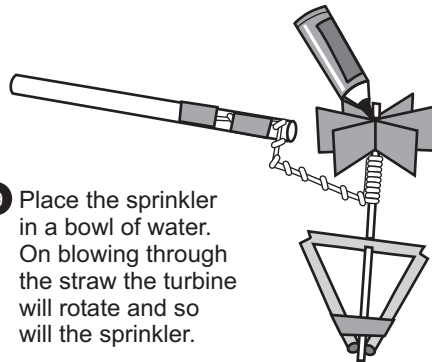
- 6 Place the sprinkler spoke in the spring.  
The spoke should be a loose fit in the spring.



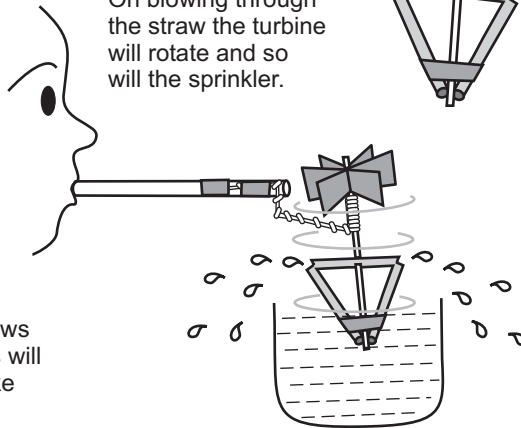
- 7 Fan fold a card strip and apply glue on one side.  
Stick the ends of the strip to make a star-shaped turbine.



- 8 Fit the turbine on the spoke and glue it in place.

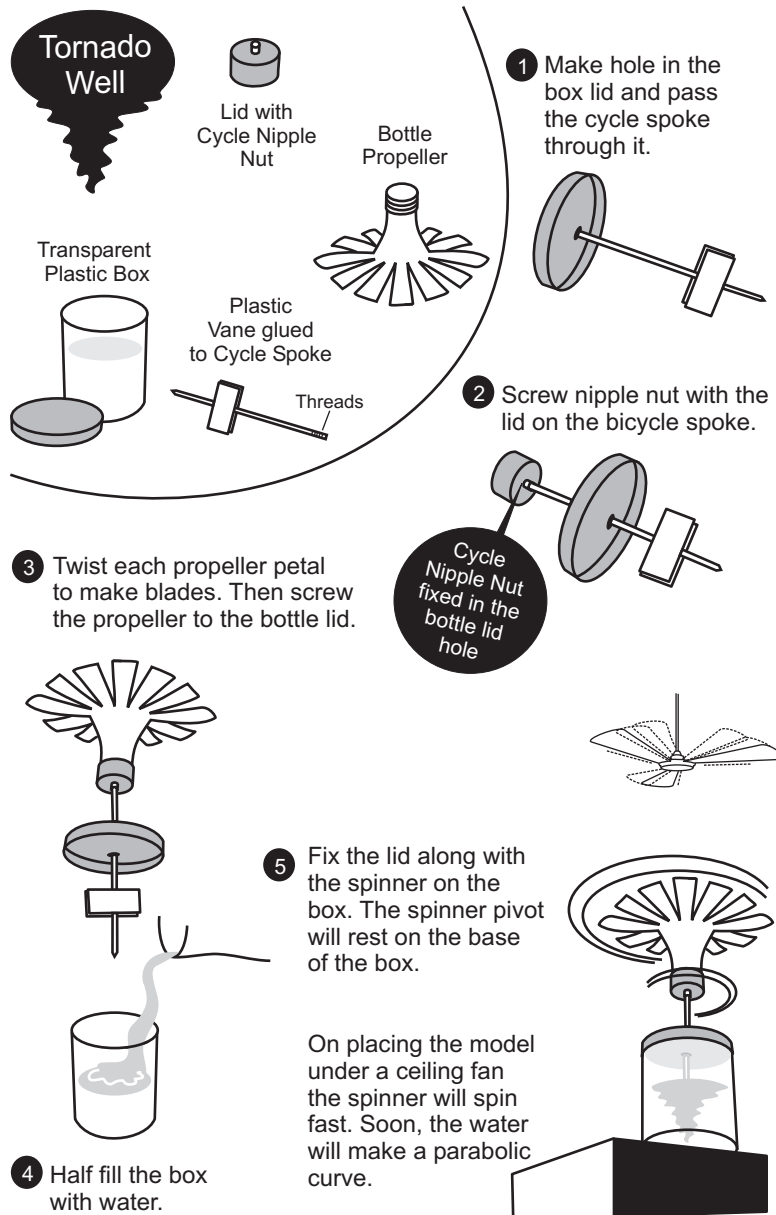


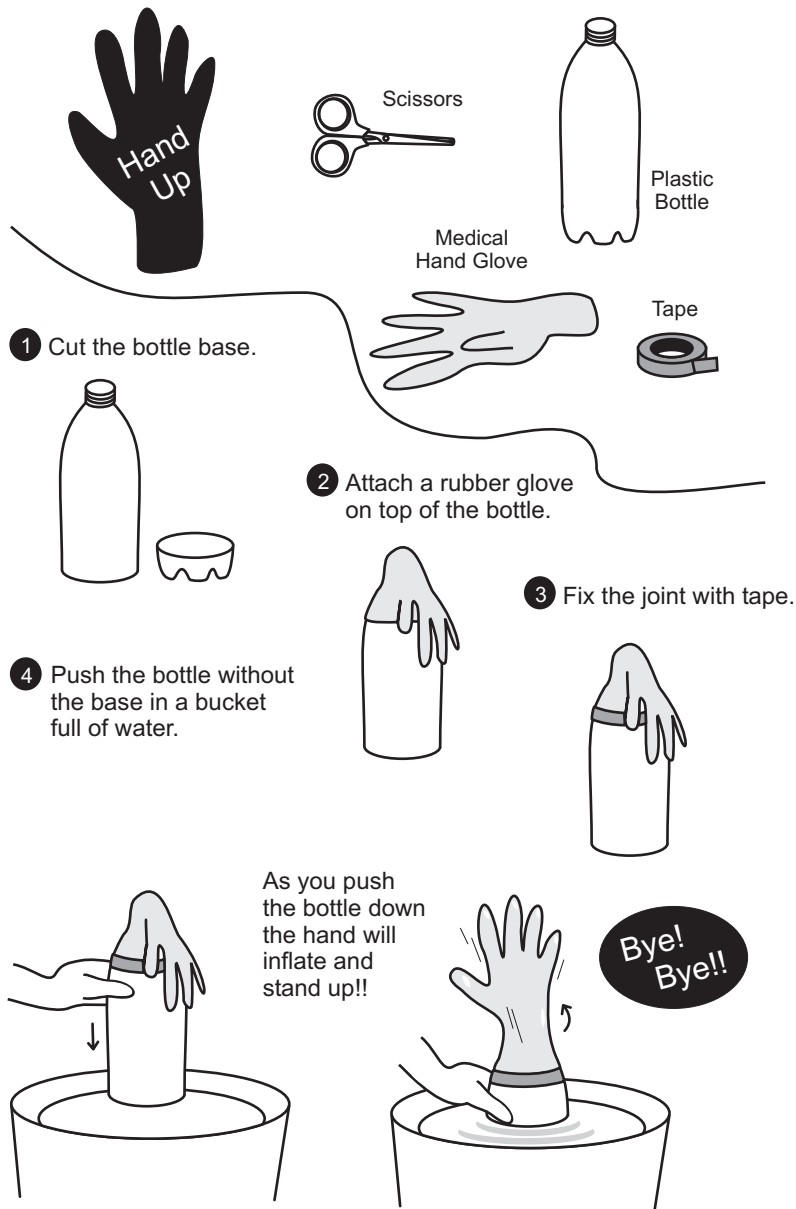
- 9 Place the sprinkler in a bowl of water.  
On blowing through the straw the turbine will rotate and so will the sprinkler.

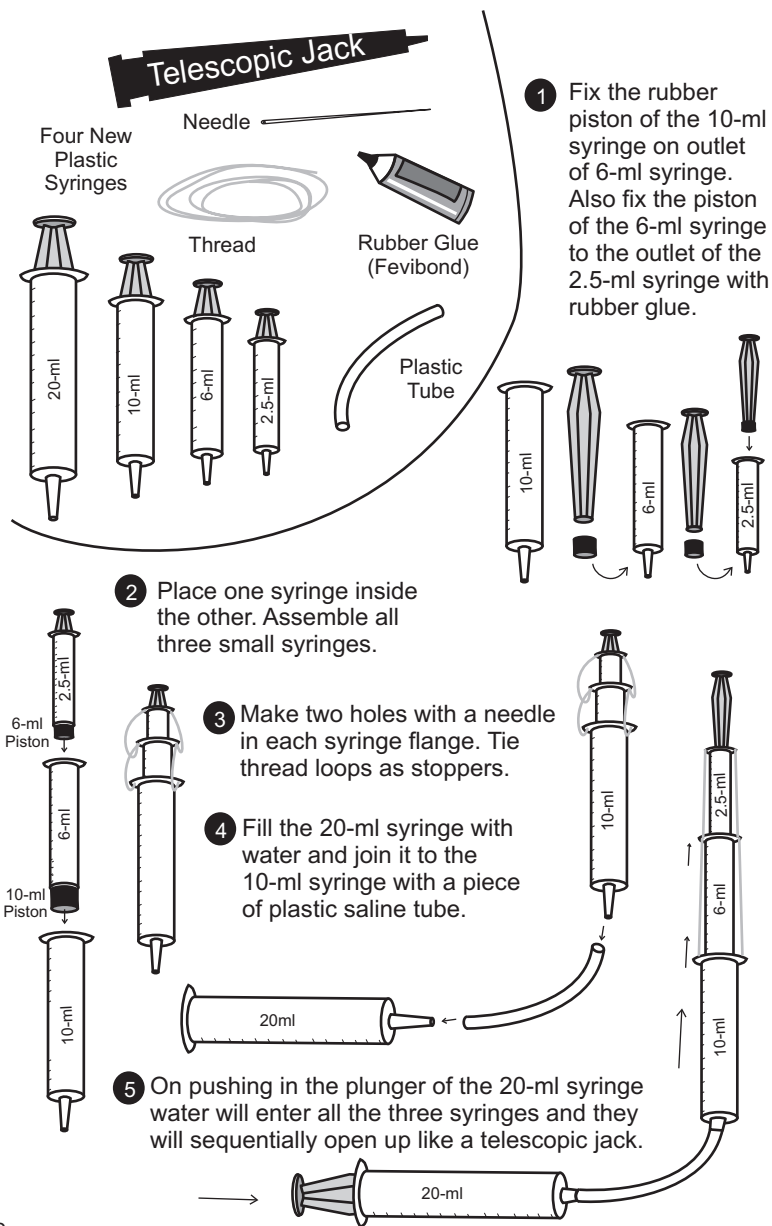


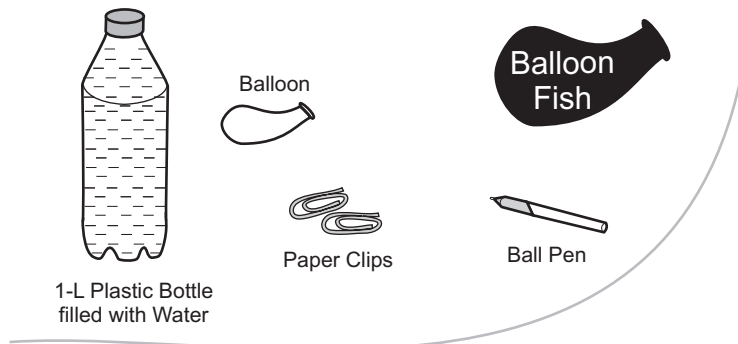
- 10 Water will climb up the slant straws and water drops will squirt all over like a real sprinkler!







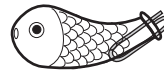




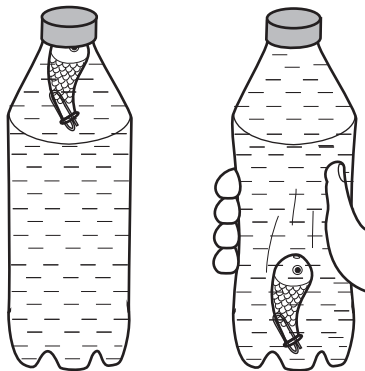
- 1 Draw a fish on the balloon with a ball pen.



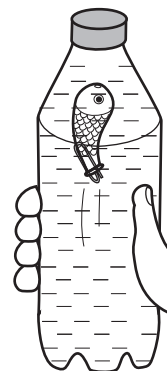
- 2 Insert two paper clips in the balloon to make it heavy. Make sure the mouth of balloon remains open.



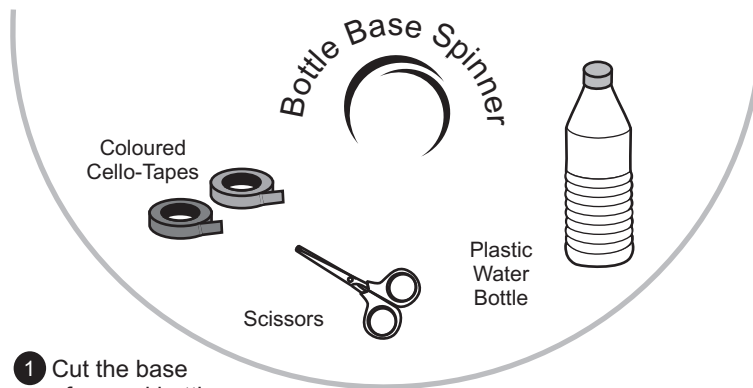
- 3 Place the balloon fish in a bottle full of water. Make sure that the balloon just floats. Then screw on the lid.



- 4 On pressing the bottle from outside a little bit of water will enter the balloon making it heavier. This will make the fish sink to the bottom.



On releasing the pressure, the extra water will gush out and the balloon fish will rise up again.



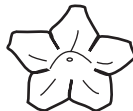
- 1 Cut the base of a used bottle using a scissors.



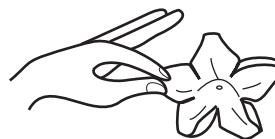
- 2 The base will have a star shaped pattern. This top will spin on the raised pip in its center.



- 3 Cut a five petal flower along the pattern with a scissors.



- 4 Twist each petal to make it into a blade.

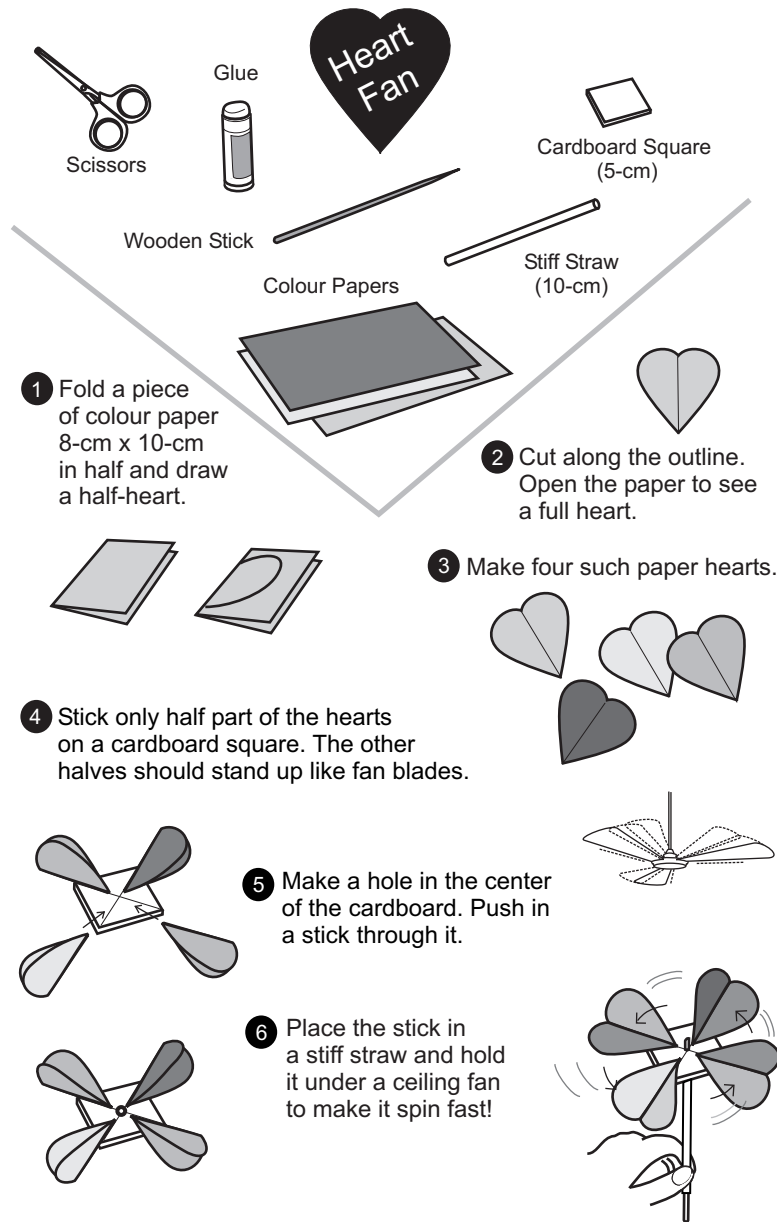


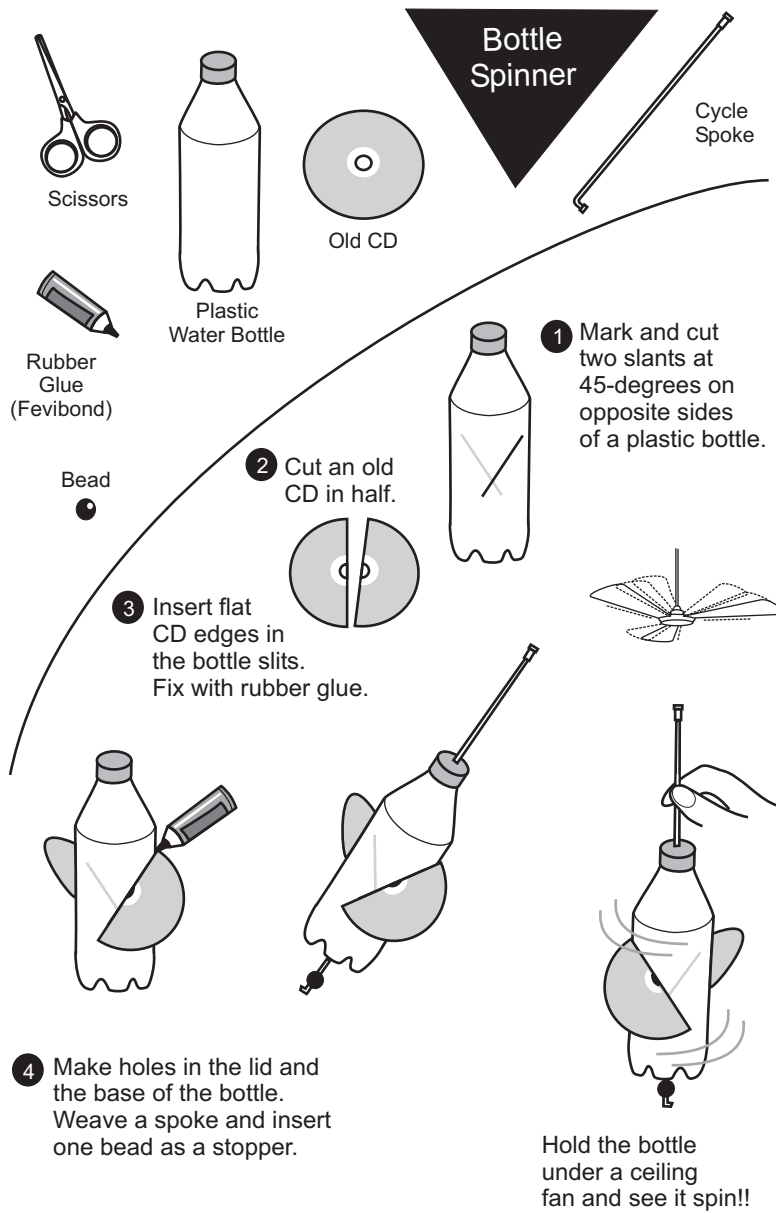
- 5 Decorate with colour tapes. Upturn and place the top on a smooth surface and blow on it.

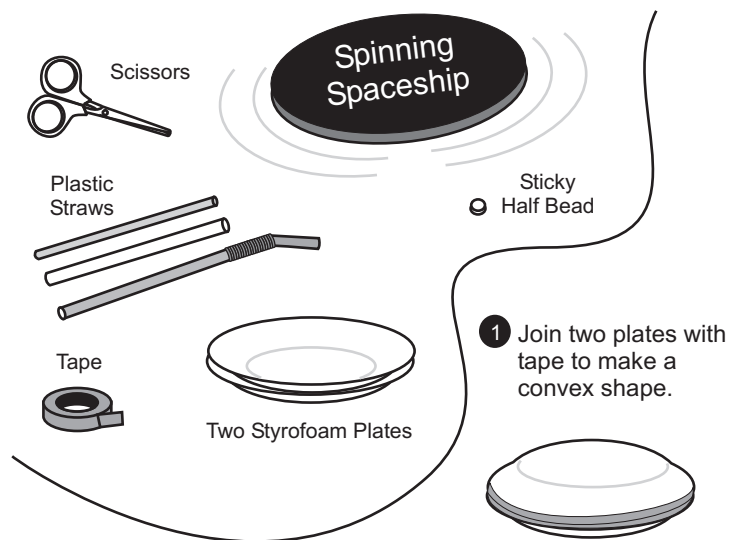


Air will strike the blades and this will spin the top very fast!!

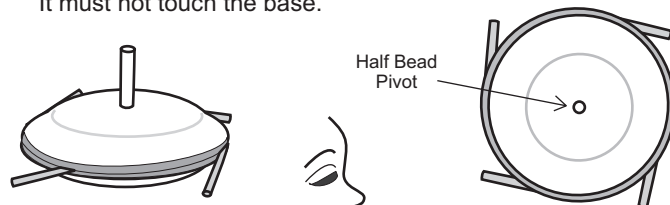




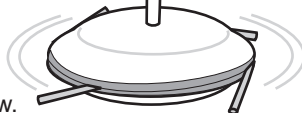




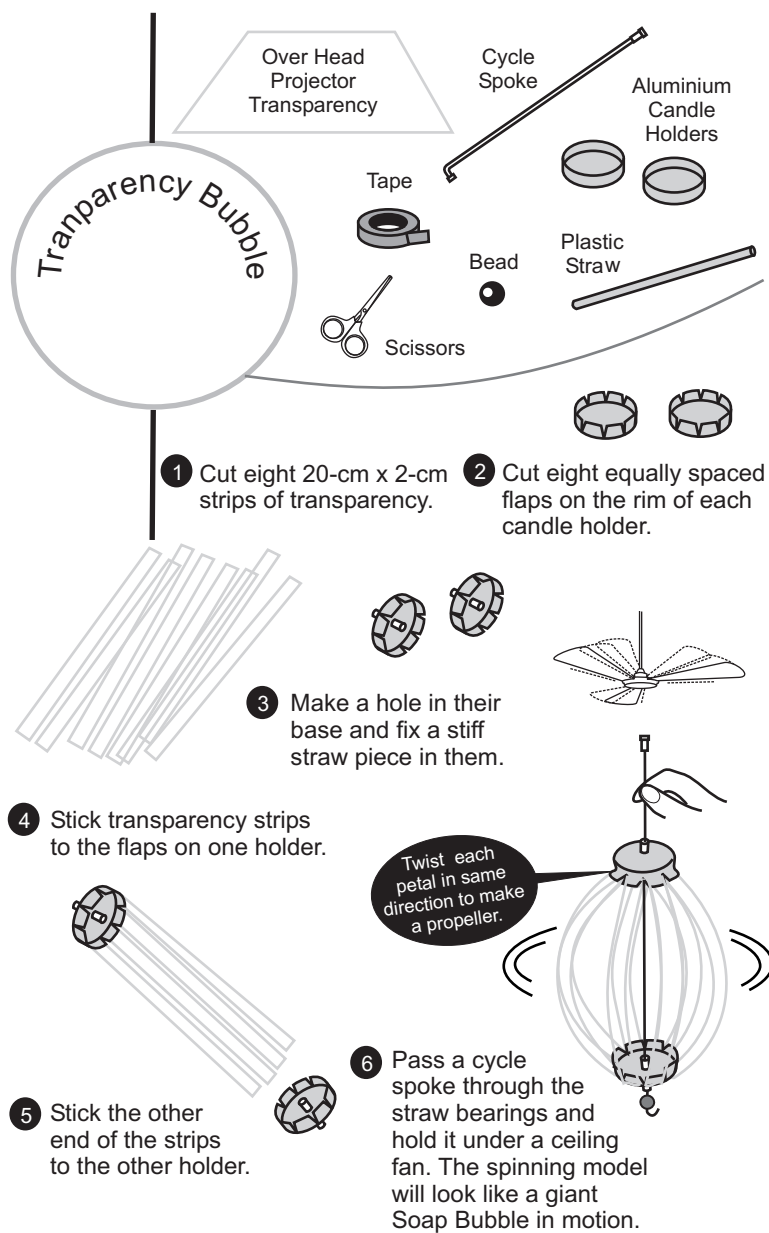
- 2 Make four holes on the joint at ninety-degrees and fix four straw pieces as shown.
- 3 Tight fit a fat straw on the top. It must not touch the base.

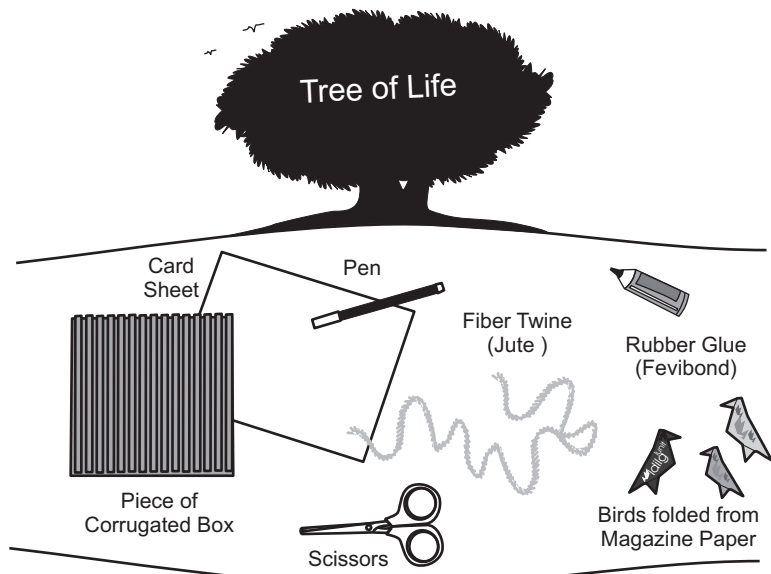


- 4 Stick a half-bead in the center of the base. The spaceship will spin on this pivot.
- 5 Insert a loose fitting bent straw in the vertical straw.
- 6 Place the model on a smooth table. Blow through the bent straw to see the plates spin like a spaceship.







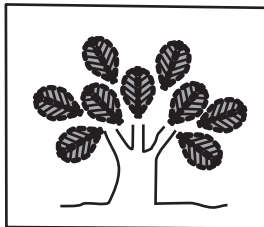


- 1 Remove the top layer of the box to see the corrugations. Draw leaves on the corrugated surface.
- 2 Cut leaves with scissors.
- 3 Cut leaves in half. Join two halves with mirror veins to resemble a real leaf.



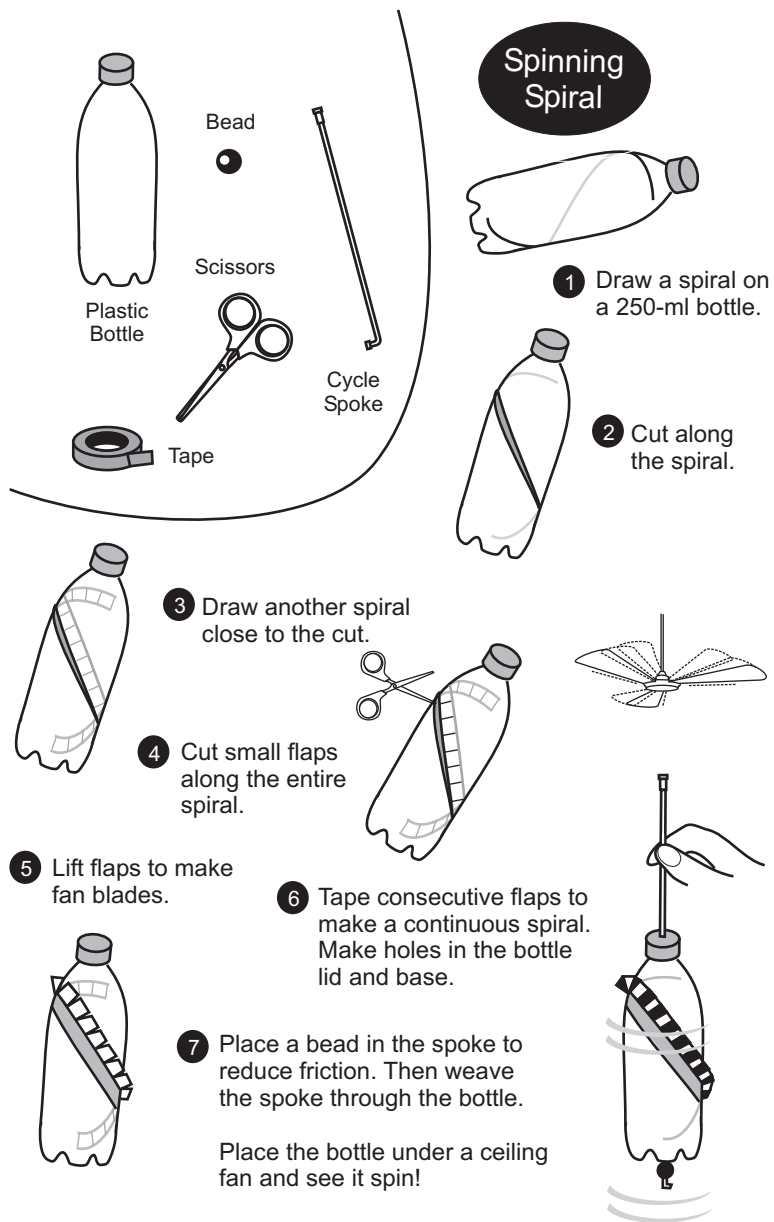
- 4 Draw the outline of a tree on a card sheet.

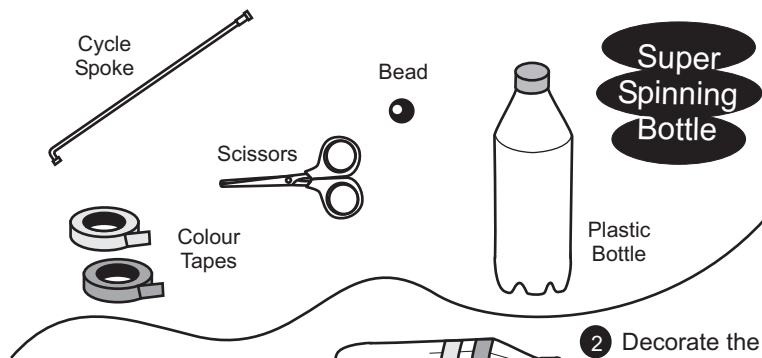
- 5 Stick leaves to make the tree crown.



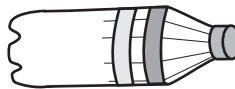
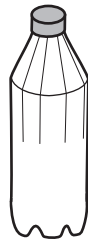
- 6 Stick twine on the trunk and branches. Glue paper birds to complete the Tree of Life.



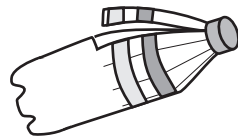




- 1 Draw 12 lines (6 sectors) on the bottle, half way along its height.

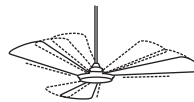


- 2 Decorate the bottle with colour tapes.

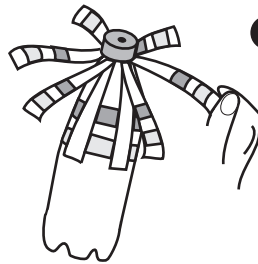


- 3 Cut on the lines to make six petals.

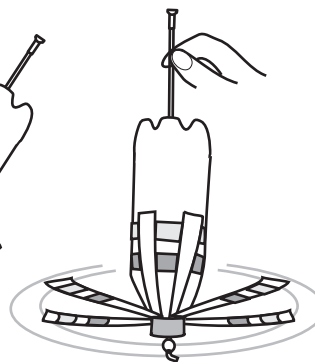
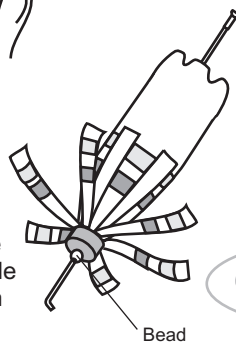
- 4 Lift the petals and twist them to make fan blades.

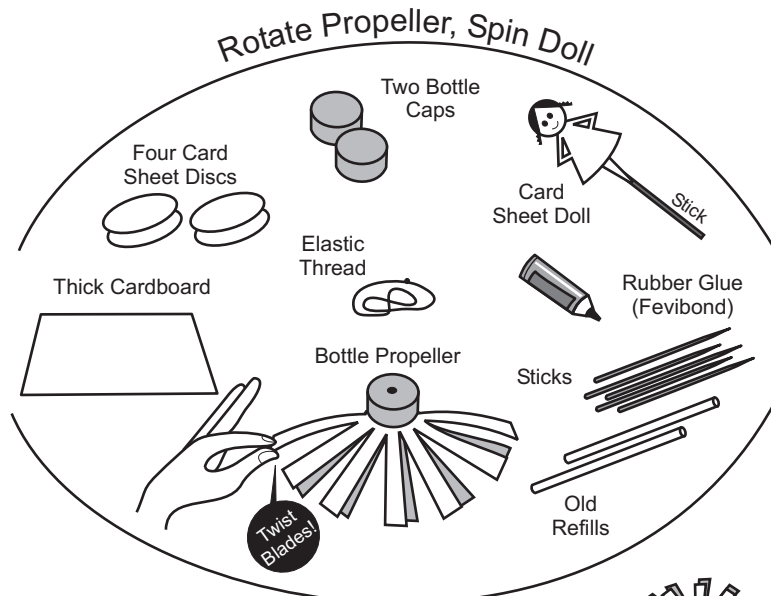


- 5 Make a hole in the lid and the base of the bottle.

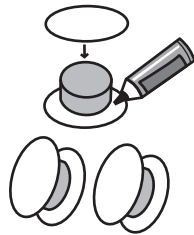


- 6 Weave a cycle spoke through the holes. Assemble as shown. Hold bottle under the ceiling fan to make it spin.

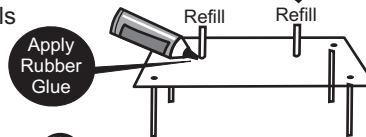




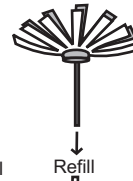
- 1 Make two pulleys using card discs and bottle lids.



- 2 Insert two ball pen refills as bearings in a thick card base.



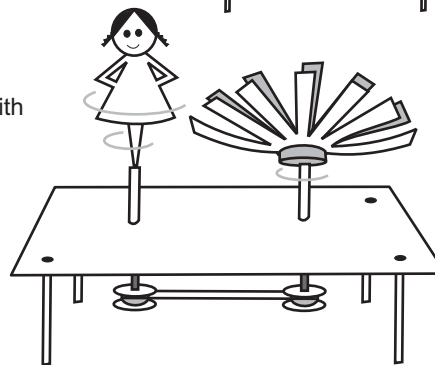
- 3 Attach a doll and propeller to two separate sticks.

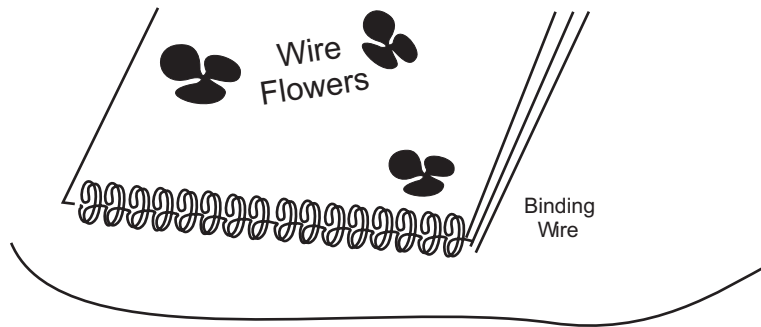


- 4 Attach pulleys to sticks with the doll and propeller.

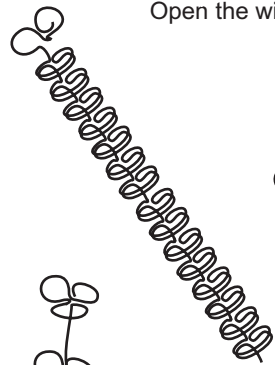
- 5 Join the two pulleys with an elastic thread.

- 6 Keep the toy under a ceiling fan. This will spin the propeller and the coupled doll will go round-and-round.

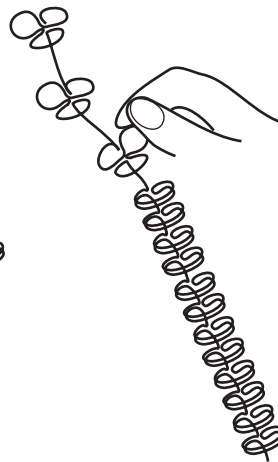
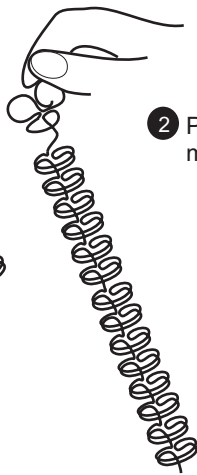




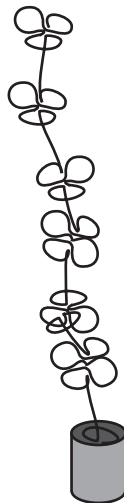
- 1 Salvage Binding Wire from an old book.  
Open the wire circles to make flower petals.

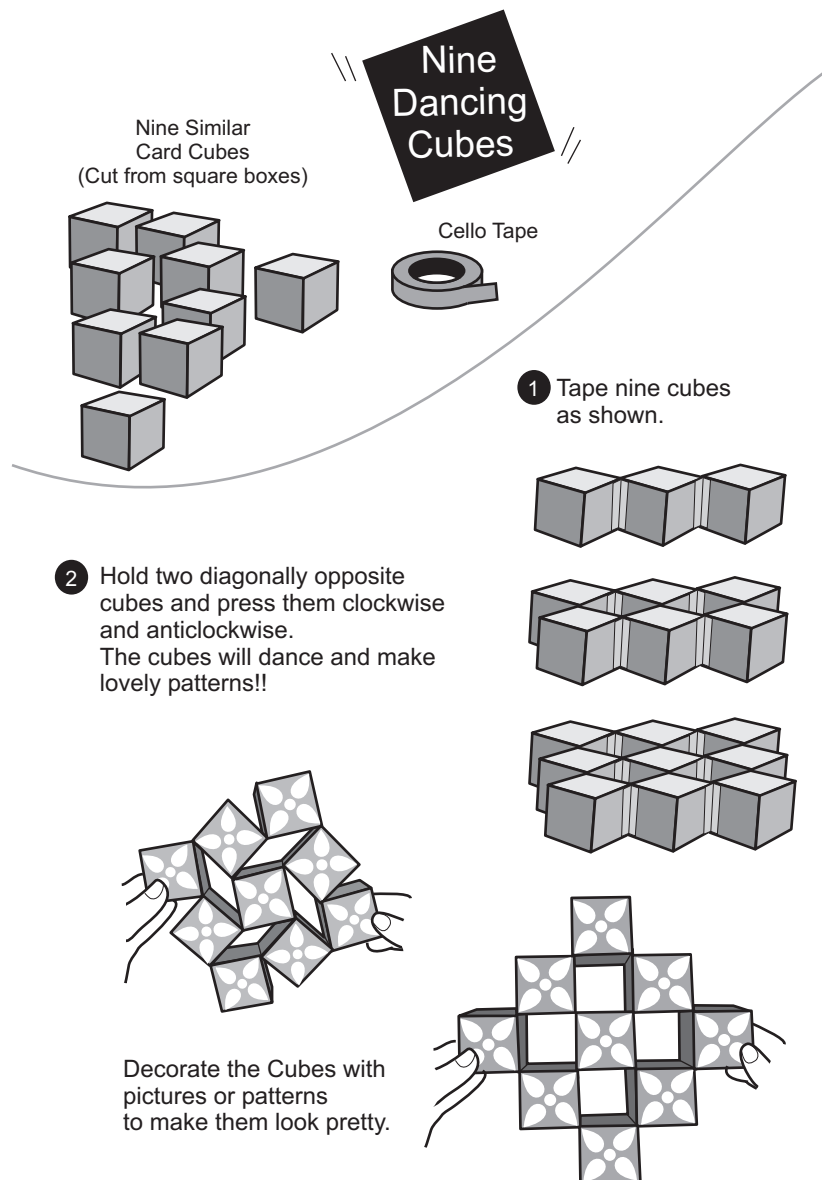


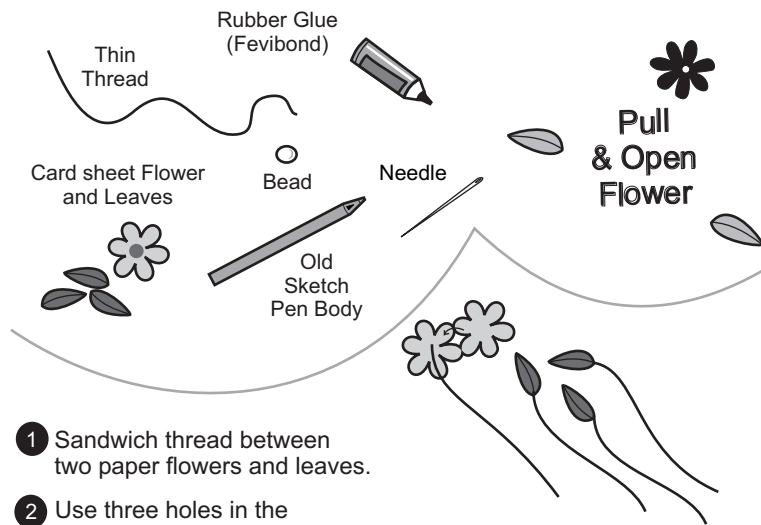
- 2 Pull wire to make the stem.



- 3 Make more flowers and then place this beautiful flower creeper in a pot.







1 Sandwich thread between two paper flowers and leaves.

2 Use three holes in the conical part and central hole of a pen body.

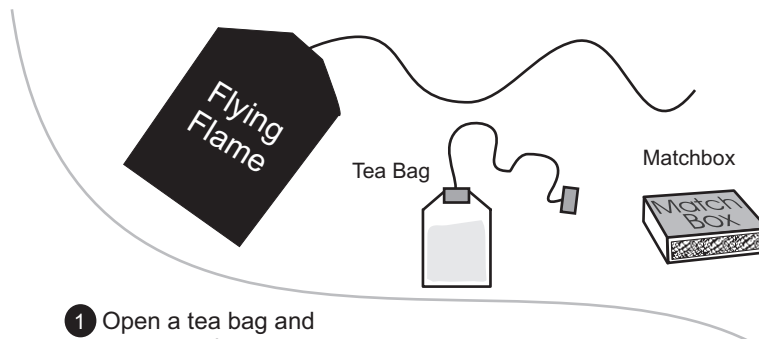
3 Pass the flower thread through the main hole and leaf threads through three separate holes in the sketch pen.

4 Tie the ends of all four threads to a bead.

5 When the thread is loose the flower and leaves appear wilted.

6 On pulling the thread the flower and leaves will stand upright and make a bouquet.

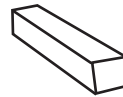




- 1 Open a tea bag and empty out its contents.

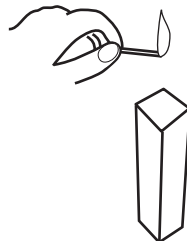


- 2 Shape the empty tea bag so that it stands vertically on the floor.

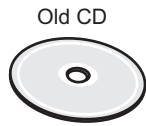


- 3 Set the bag on fire. The burning bag will become light and the trapped hot air inside it will.....

Seek  
Adult  
Help



...ultimately lift it up  
magically in the air!



Old CD

Food Colour



Two Glasses

Seek  
Adult  
Help

1 Fill a glass completely with hot water.

2 Add some food colour and stir well.

3 Fill another glass with cold water.



4 Cover the cold water glass with an old CD.



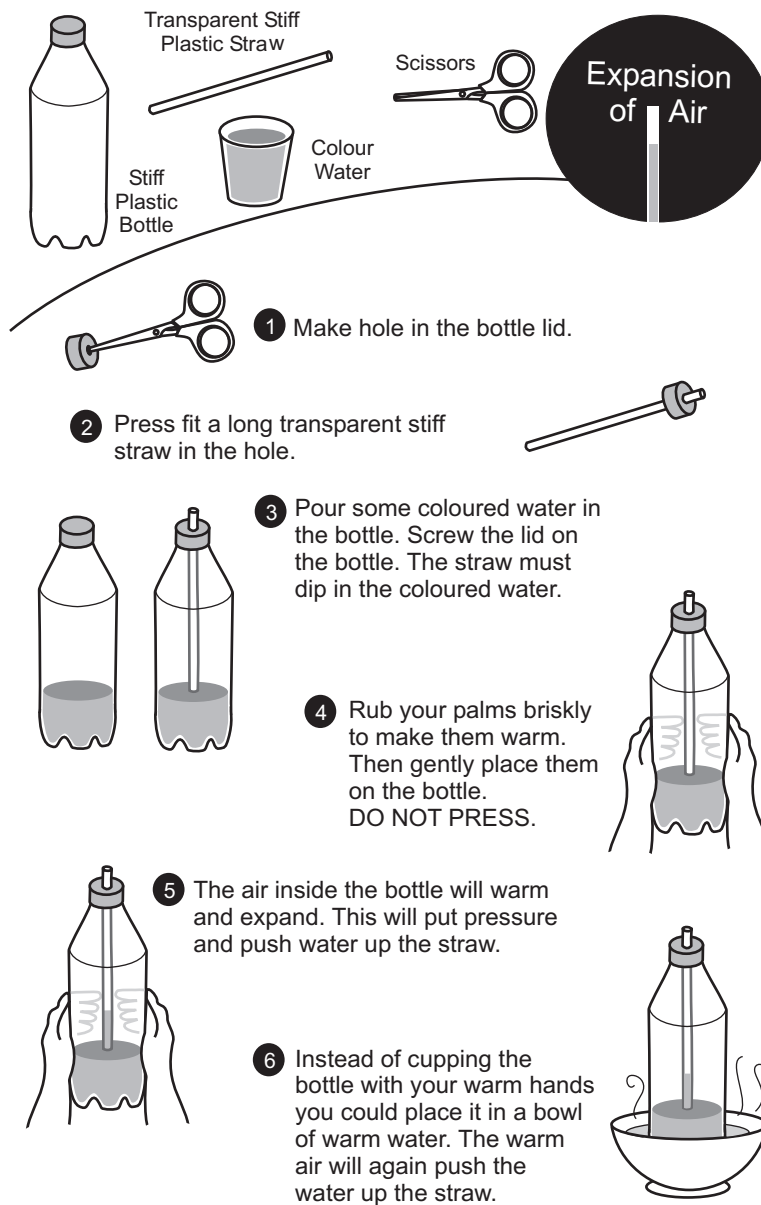
5 Cover the CD hole with your fingers and invert it gently on the coloured water glass.

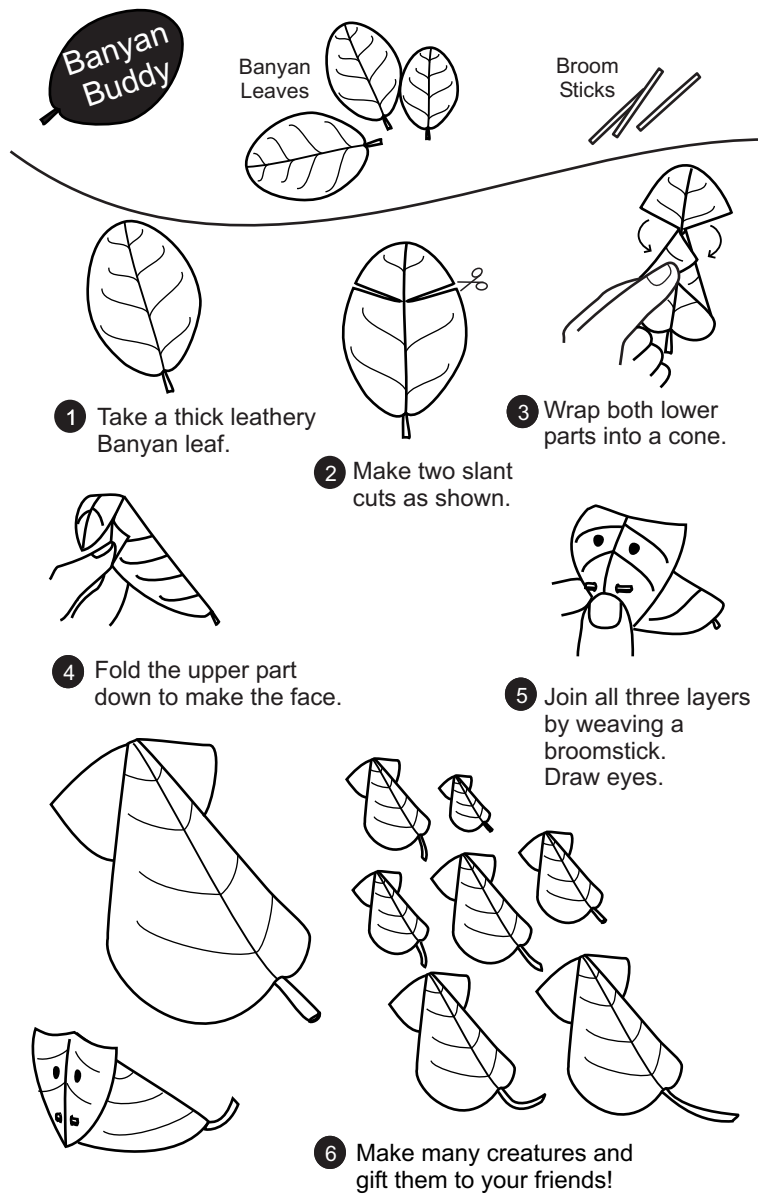


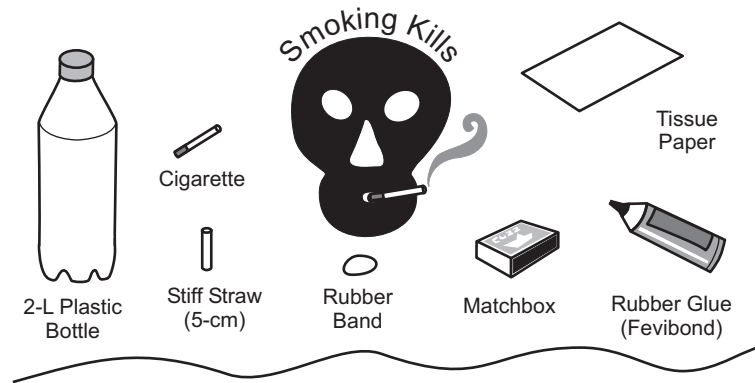
Soon you will see amazing convection currents going up!



After a while the temperature and colour of water in both glasses will become the same.







- 1 Make holes in the bottle lid and near the base of the bottle.
- 2 Press fit the cigarette filter in the lid.
- 3 Press fit a stiff straw near the bottle base. Seal the joint with glue.

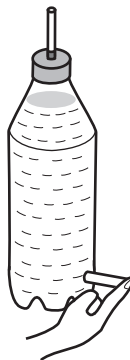
- 4 Close the pen end with your finger and fill the bottle with water.



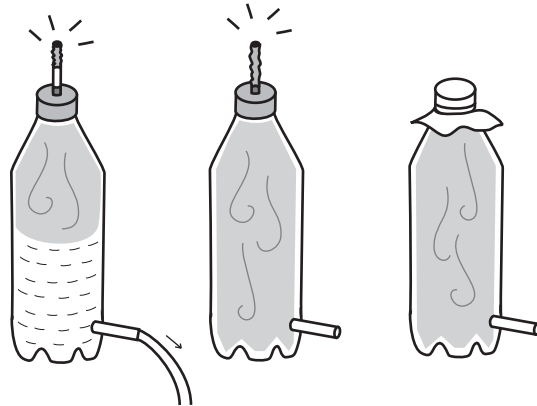
- 5 Screw lid with the cigarette on the bottle.

- 6 Now, light the cigarette.

- 7 Then open the straw end so that water starts to flow. As water flows out, smoke will be sucked inside the bottle.

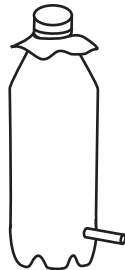


- 8 When the bottle gets filled with smoke, place a double layer of tissue paper on the bottle mouth. Tie it with a rubber band.

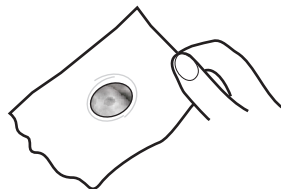
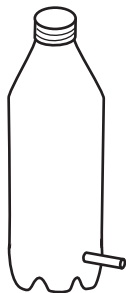


- 9 Place the pen in your mouth and blow out. Slowly the smoke will pass through the tissue paper.

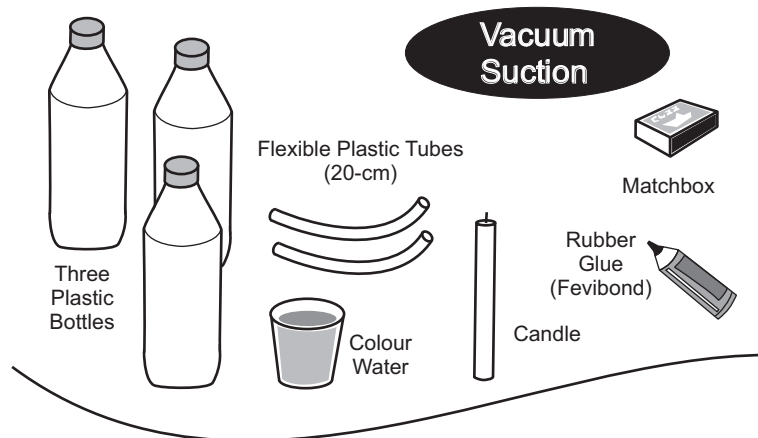
Seek  
Adult  
Help



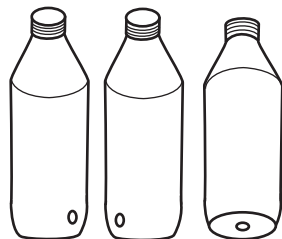
As smoke passes through the tissue paper the bottle will become transparent.



- 10 Finally, remove the rubber band and inspect the tissue paper. The tissue paper will be smelly and dark black with all the tar and other deadly chemicals. This experiment conclusively demonstrates the harmful effects of smoking!



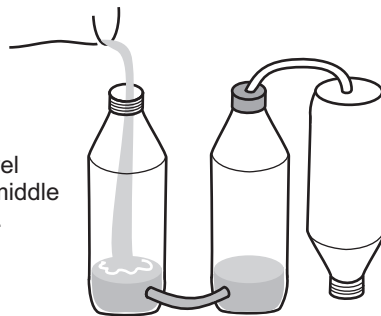
- 1 Make three holes in the bottles as shown. Also make a hole in one lid.



- 2 Join the bottles with two short plastic tubes as shown. Seal all joints with rubber glue.



- 3 Pour colour water in the left bottle. The level of water in the left and middle bottles will be the same.



4 Then light a candle.



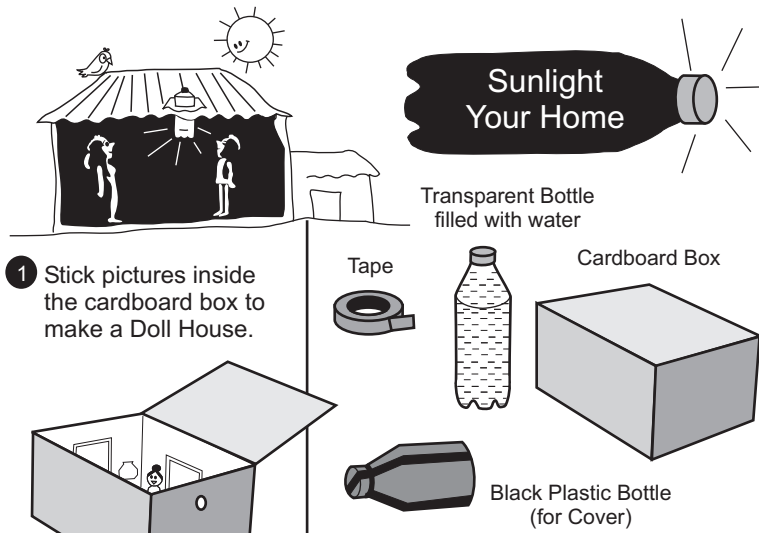
5 Carefully invert the right hand bottle on the burning candle. Keep the bottle pressed down.



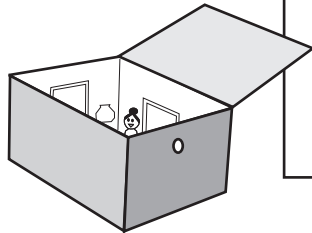
Seek  
Adult  
Help

6 After a while the candle will consume all the oxygen in the bottle and will extinguish. A partial vacuum will be created and some water will be sucked into the middle bottle. The level of water in the middle bottle will rise.

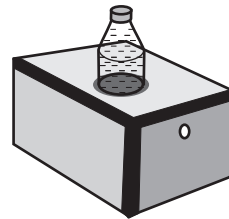




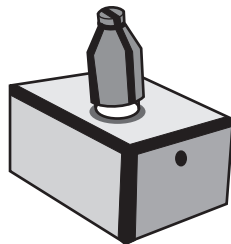
- 1 Stick pictures inside the cardboard box to make a Doll House.



- 2 Seal all the joints with tape. Make a peep hole on one side. Make another hole on top to suspend a water bottle.



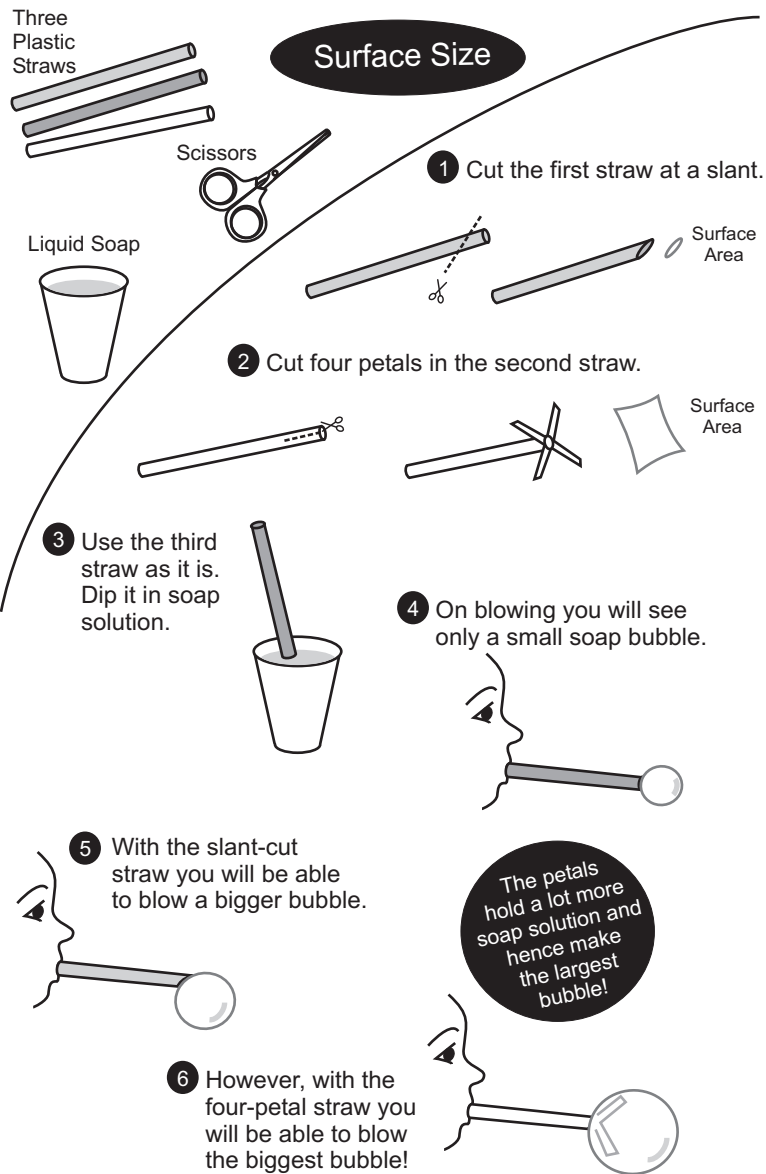
- 3 Suspend a transparent bottle filled with water in the box. Half bottle will be out and half will be inside the box.
- 4 Go out in the Sun. View through the peep hole. You will see the Doll's House brightly lit.

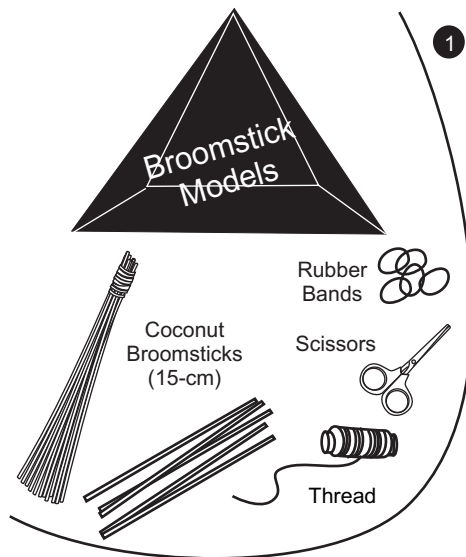


- 5 Cut a bottle in half and cover it with black paper.

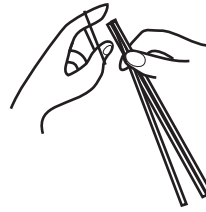


- 6 Camouflage the water bottle with the covered bottle. It will be pitch dark inside. Lift the cover to see bright light inside the box.



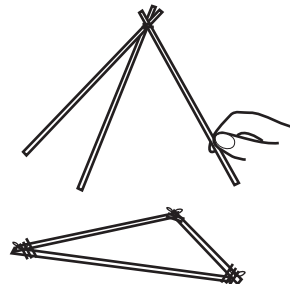


- 1 To make a Tetrahedron you will need six broomsticks and four rubber bands. Take three sticks and join them with a rubber band.

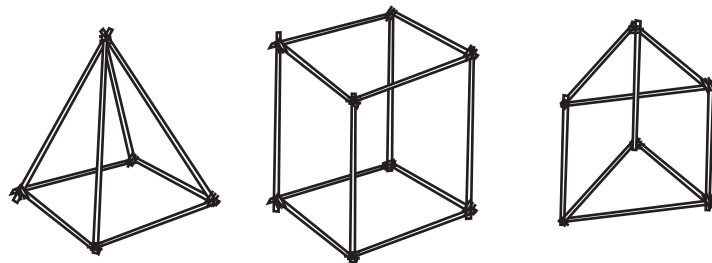


- 2 Make a triangle with three more sticks. Join each end of the tripod to one vertex of the triangle...

- 3 ... to complete the Tetrahedron!

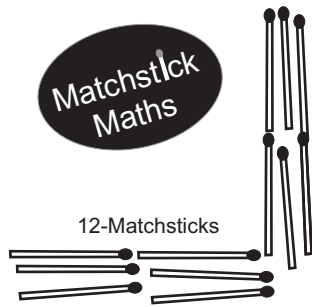


Make different shapes - Pyramids, Cubes, Prisms etc. The rubber bands decay after a while. For permanent joints tie all the junctions with thread. This is a very low-cost way of making 3-D models.

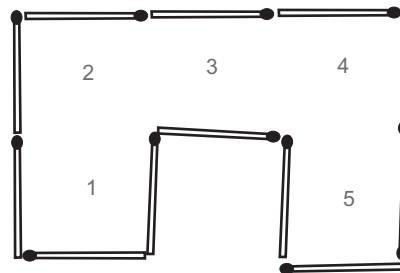


# Matchstick Maths

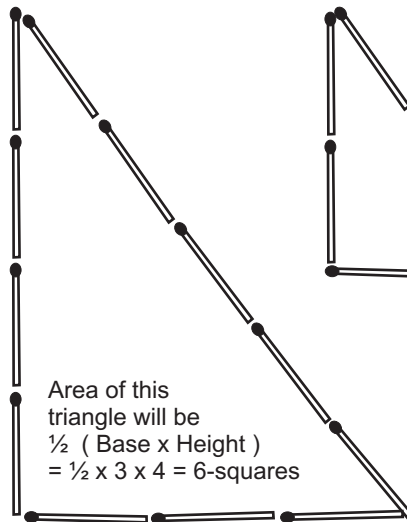
12-Matchsticks



- 1 This shape made with 12-matchsticks has an area of five squares.

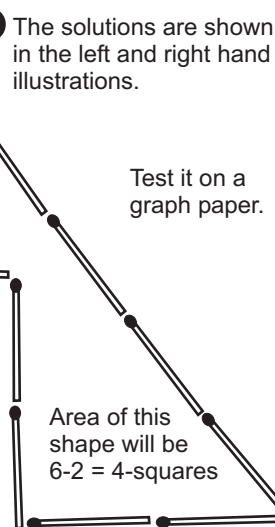


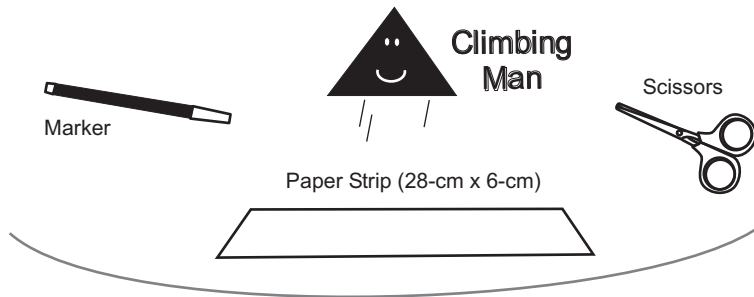
- 2 Now arrange the same 12-matchsticks to enclose an area of six and four squares.



- 3 The solutions are shown in the left and right hand illustrations.

Test it on a graph paper.

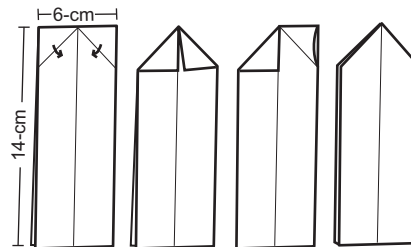
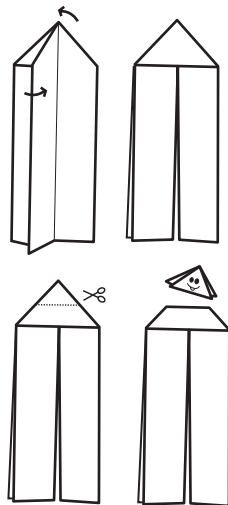




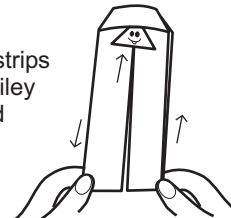
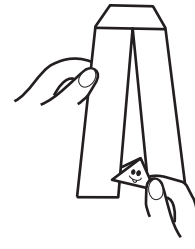
- 1 Fold strip in half and then in a quarter.
- 2 Open strip and fold two small triangles on top.
- 3 Open triangles and then squash them inwards.

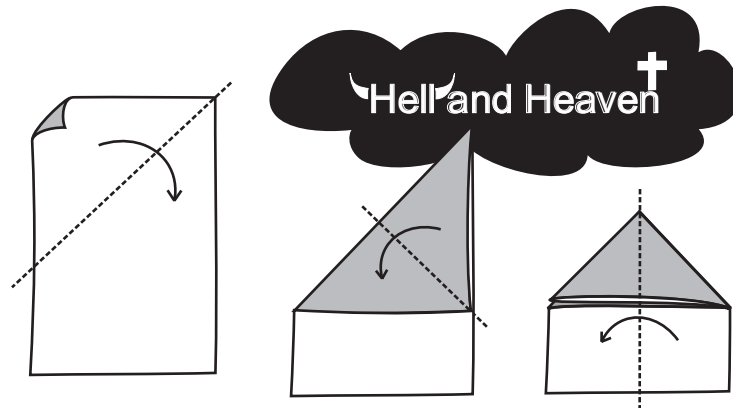


- 4 Fold the arrow shape so as to see two separate strips below.



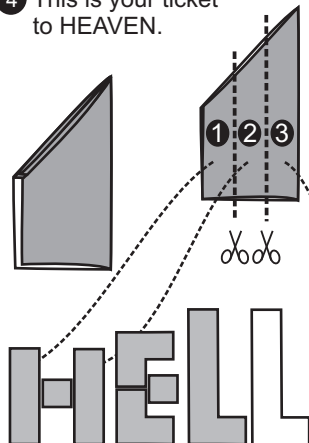
- 5 Cut the top of the triangle.
- 6 Draw a smiley face on the triangle.
- 7 Tuck the smiley between the two strips.
- 8 On moving the strips up-down the smiley will climb up and get ejected!!



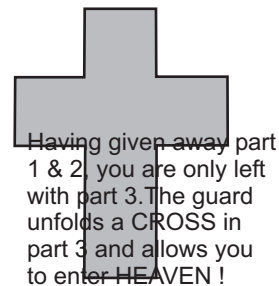


- 1 Take half A-4 sheet. (21-cm x 15-cm)  
Fold top left corner to make a triangle.
- 2 Fold top triangle in half.
- 3 Fold model in half from right to left.

- 4 This is your ticket to HEAVEN.

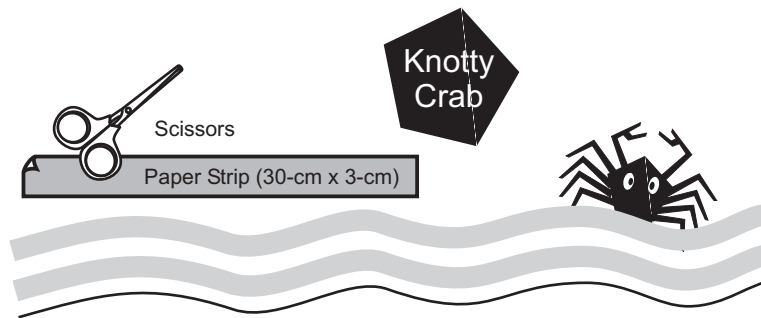


- 5 Who doesn't want to go to HEAVEN? A greedy person wants part of your ticket. Being generous you cut part 1 and give it to him. But he wants more. So, you cut part 2 and give that too.

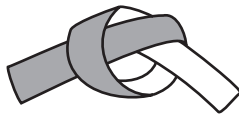


- 6 Armed with parts 1 and 2 the greedy man tries to enter heaven. The guard assembles parts 1 and 2 and makes the word HELL. "Your place is in HELL," the guard tells him. "Go to HELL".

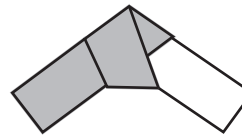
7



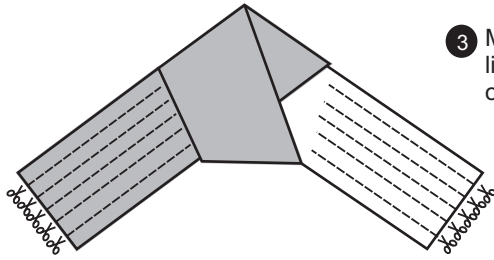
- 1 Tie a knot in a strip of paper 30-cm long and 3-cm wide.



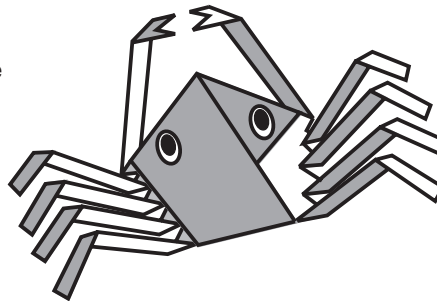
- 2 On pulling both ends and tightening the strip you will see a regular pentagon in the middle.

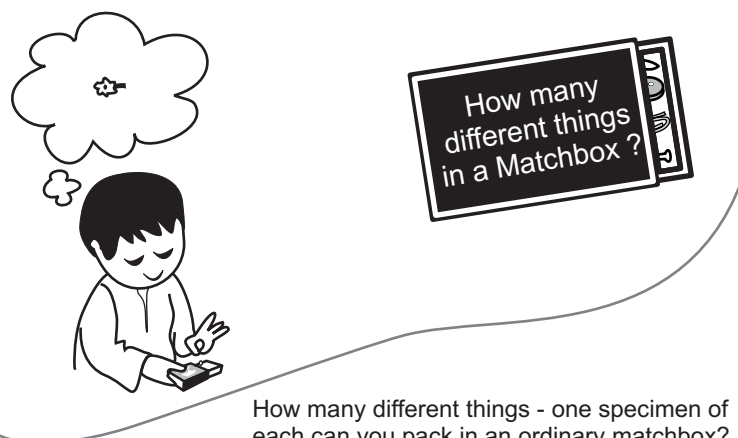


- 3 Mark and cut five parallel lines on both strips jutting out from the pentagon.



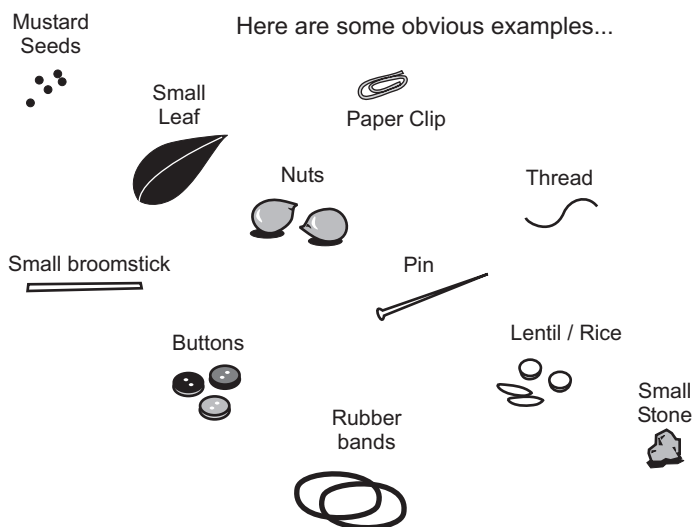
- 4 Fold the top strips to make two jaws. Fold and shape lower strips to make the legs and feet of the crab. Finally draw two eyes and then admire your KNOTTY CRAB!





How many different things - one specimen of each can you pack in an ordinary matchbox? For this you will have to look for the littlest and tiniest things around you.

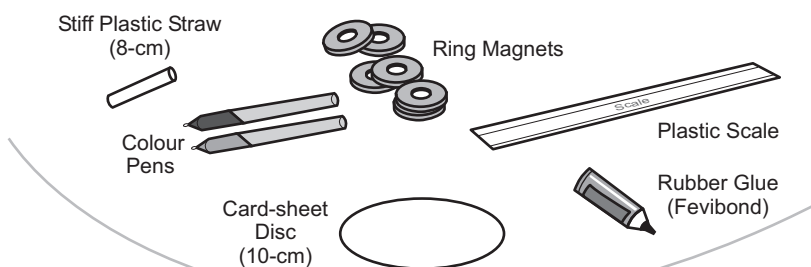
Here are some obvious examples...



In 1980, the Vikram Sarabhai Community Science Center, Ahmedabad, India organized a competition for children - How many different things, one of each can you pack in a matchbox? One child packed more than 250 things in one single matchbox! The word Nano had not be invented then. Today's children will easily surpass that record. This is a still a great science activity for school children.



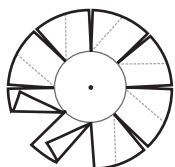
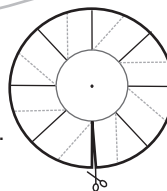
## Magnetic Rotation



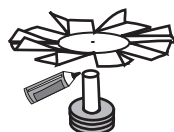
- 1 Tight fit a piece of straw in three ring magnets.



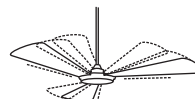
- 2 Draw this pattern on a 10-cm card sheet disc as shown. Cut along the bold lines.



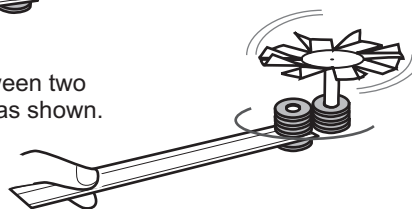
- 3 Fold on the dotted lines to make fan blades.



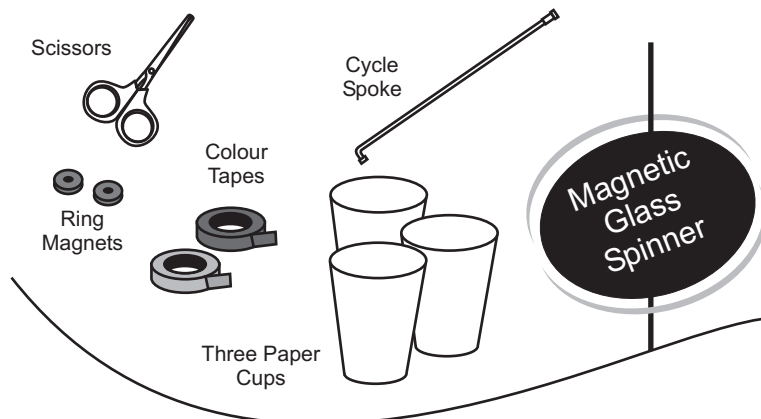
- 4 Stick top of the straw to the spinner.



- 5 Sandwich a plastic scale between two layers of magnets. Assemble as shown.



Hold the assembly under a ceiling fan. The card spinner will spin and also rotate round-and-round the magnets on the scale.



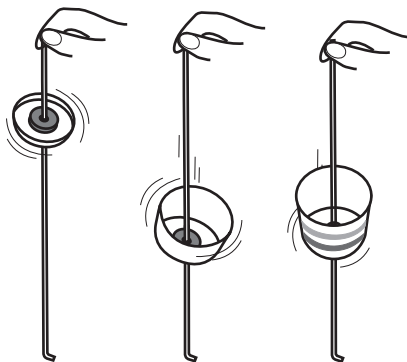
- 1 Cut the cups as shown in quarter, half and three-fourths.
- 2 Make a hole in center of the base and decorate the cut cups with colour tapes.



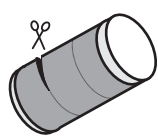
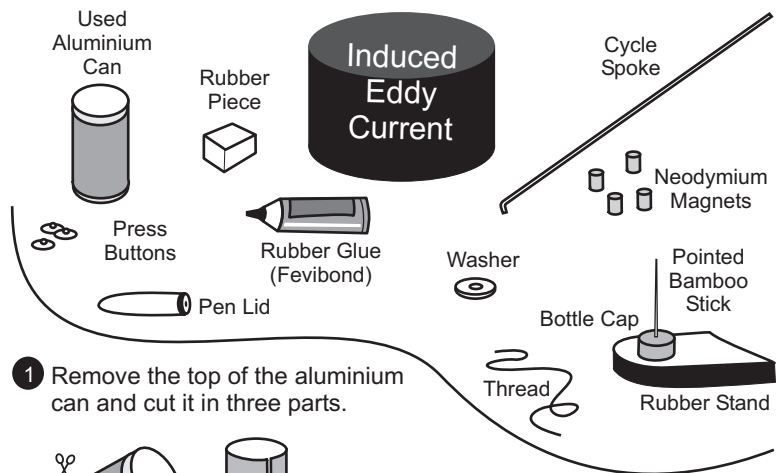
- 3 Fix two ring magnets on the hole. One above and the other from below.



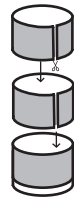
- 4 Place the cup with the magnets in a cycle spoke. Hold the spoke loosely on top.
- 5 Give the cup a gentle twirl. The cup will keep spinning and slowly come down.



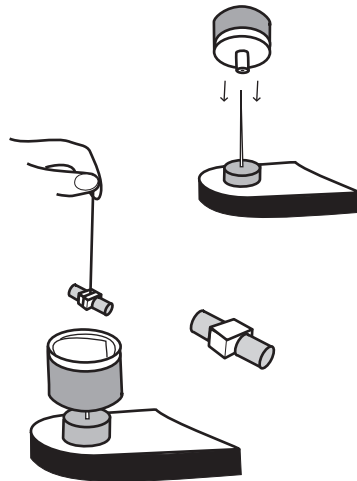
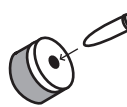
- 6 Repeat the experiment with the other two cups. You will find that the bigger the cup, the slower it will spin.



- 2 Cut the two top hoops. Press and place them in the base. This will make the wall of the base can thicker.

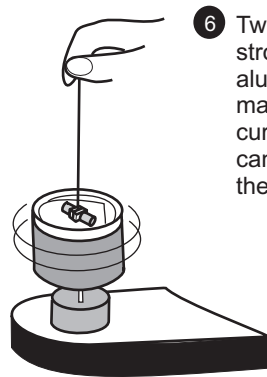


- 3 Make a hole in the can base and fix a pen lid with a small washer.

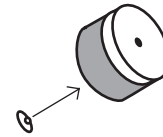


- 4 Place the aluminium can on the tip of a sharp bamboo stick so that it can spin freely. The pen lid and washer will make a good bearing.

- 5 Fix two strong cylindrical magnets on a piece of rubber. Tie a thin thread to the rubber. The magnets must spin freely on the thread.

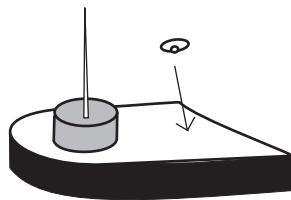


- 6 Twist the thread and spin the strong magnets inside the aluminium can. The spinning magnets will create eddy currents in the aluminium can. This will make the can spin too.

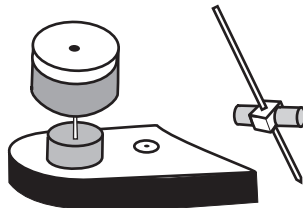


- 7 Make a small hole in the base of an aluminium can and fix the pip of a press button. This will make a very smooth bearing.

Spinning magnets should not touch the can

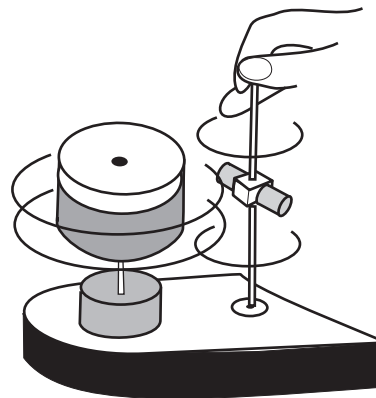


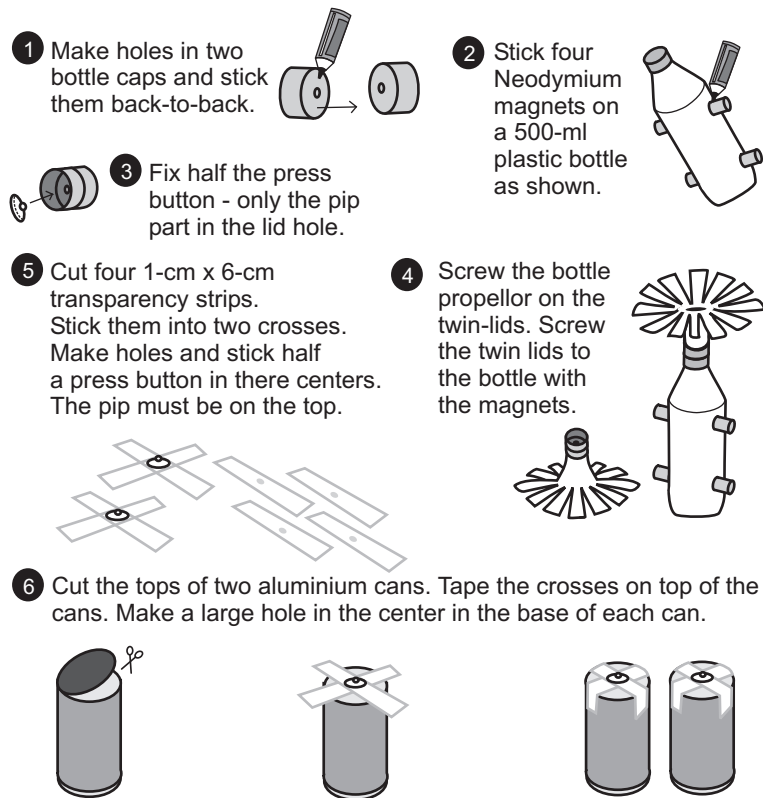
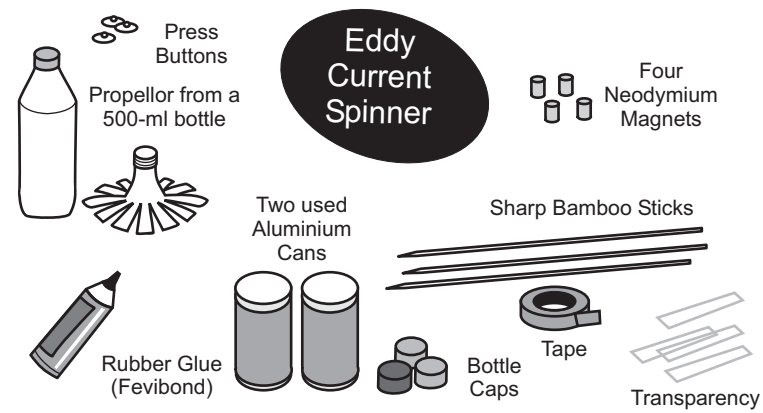
- 8 Fix another press button in the rubber base of the stand. This depression will enable you to spin the magnets close to the can.

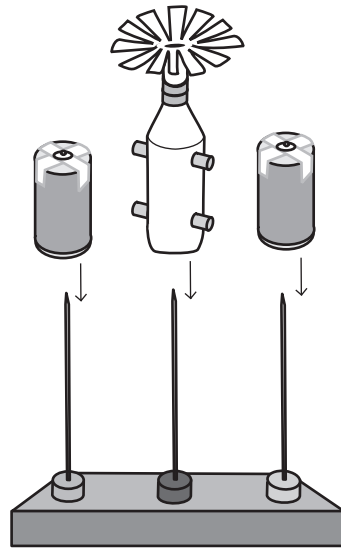


- 9 Perch the aluminium can on the pointed bamboo stick as before. Pierce a cycle spoke through the rubber between the two magnets.

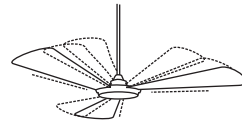
- 10 Place the tip of the spoke in the press button and spin it near the can. The magnets must not touch the aluminium can. The spinning magnetic field will produce eddy currents in the aluminium can and it will spin too!



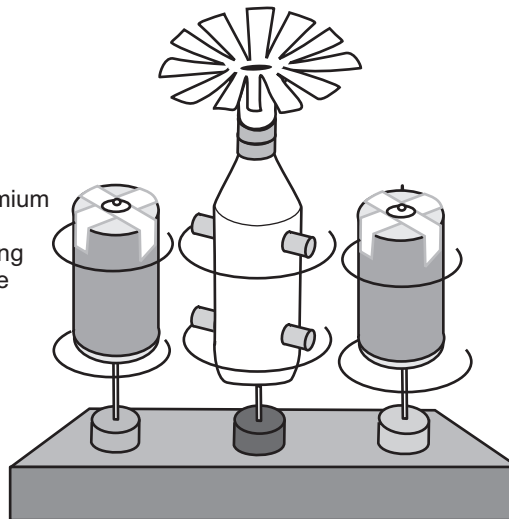


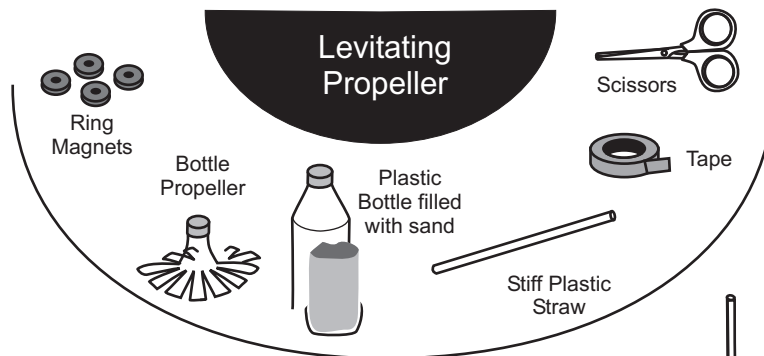


- 7 Fix three sharp bamboo sticks (skewers) on three bottle caps. Stick the caps on a wooden block. Perch the bottle with the magnets on the middle stick and the aluminium cans on the two end sticks. The tip of the sticks must perch on the press buttons. Then place the model under a ceiling fan.

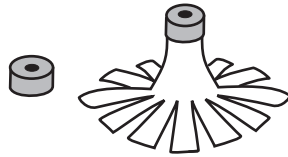


- 8 The breeze from the ceiling fan will spin the propeller and the bottle. The strong neodymium magnets will also spin. These spinning magnets will create eddy currents in the aluminium cans and they will start spinning too!





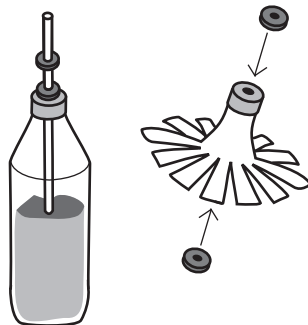
- 1 Make a propeller from a 500-ml plastic bottle. Make a hole in the bottle lid.



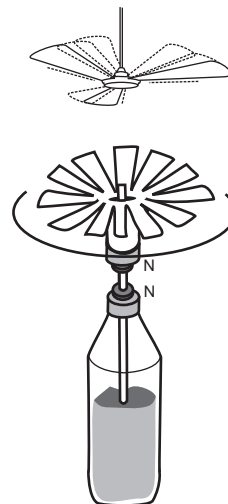
- 2 Screw the lid with the hole on a bottle half filled with sand. Press fit a stiff straw in the lid. Embed the straw in the sand to make it stand erect.



- 3 Place a few ring magnets in the straw. Similar poles will repel each other.

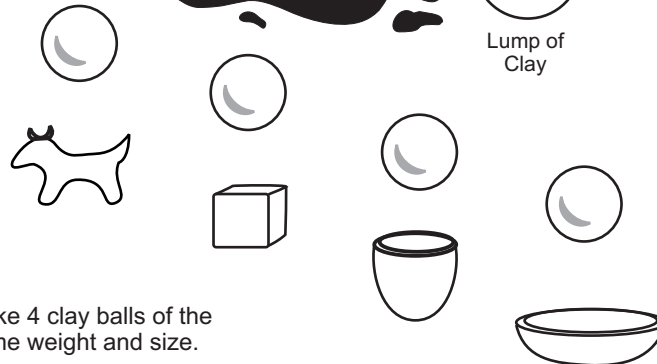


- 4 Place two magnets each inside and outside the propeller lid. These magnets will automatically stick to each other.



- 5 Place the propeller on the stiff straw. The magnets in the straw and the propeller should repel each other. This will make the propeller levitate. On placing it under a ceiling fan the propeller will spin very fast!

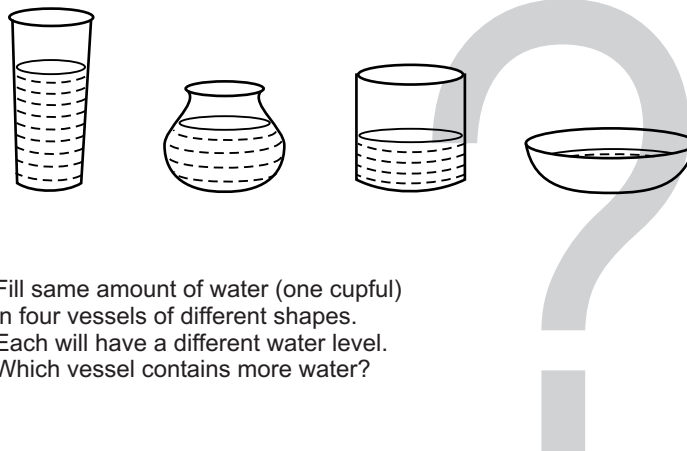
## Conservation of Weight & Volume



1 Make 4 clay balls of the same weight and size.

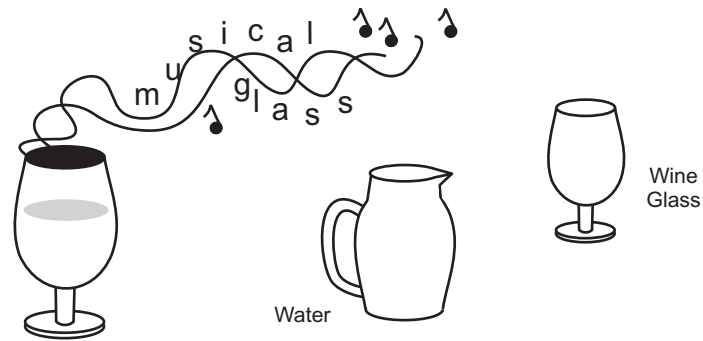
2 Then transform each ball into a different shape - animal, cube, cup and a saucer.

Ask your friend, "Which shape is heavier?"  
Each shape was made from a similar ball.  
So how can they have different weights?



Fill same amount of water (one cupful)  
in four vessels of different shapes.  
Each will have a different water level.  
Which vessel contains more water?





- 1 Rub your wet finger on the rim of a wine glass. You will hear a musical note.



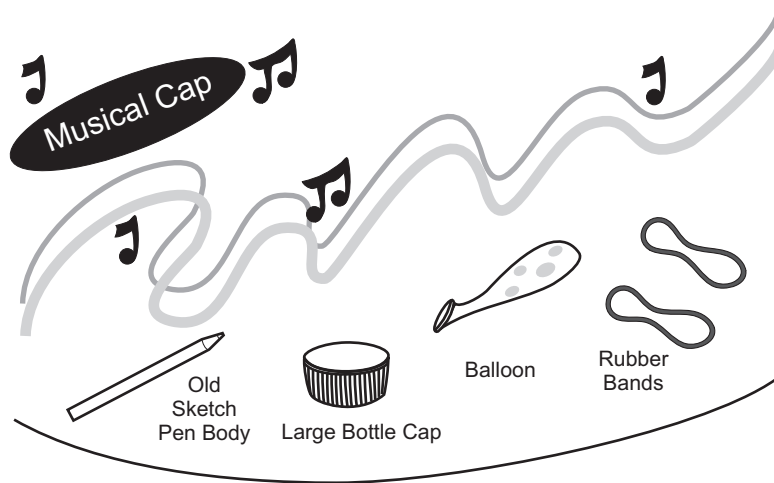
- 2 Then fill the wine glass half with water. On rubbing the rim the note will change.



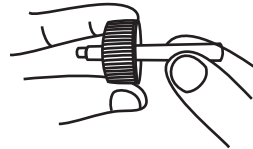
- 3 Keep adding more water and try again.

As you add more water the musical note will get less shriller. The musical note is produced by the vibrating water in the wine glass.

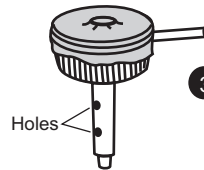
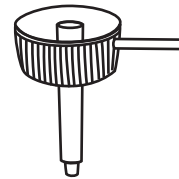




- 1 Make a 8-mm hole in the bottle lid with a scissors. Press fit a 8-cm long old sketch pen piece in the hole.



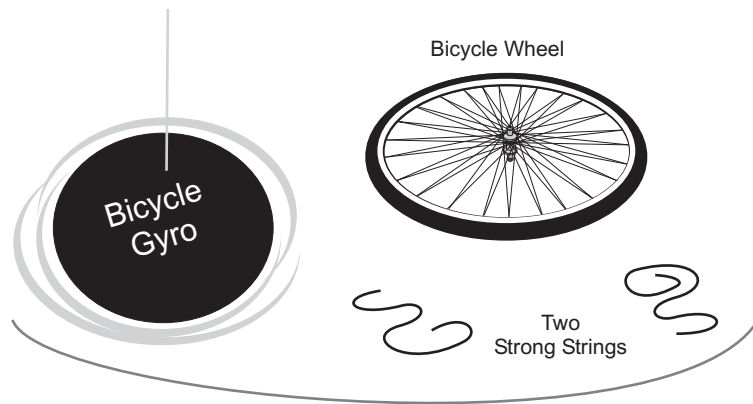
- 2 Make another small hole in the rim of the lid. Press fit a 5-cm long ball pen refill in this hole.



- 3 Stretch a torn balloon on the lid. Place rubber bands to keep it stretched.

- 4 Push the sketch pen so that it just touches the balloon. On blowing through the refill you will hear a sound. Open and close the holes to hear different musical notes.

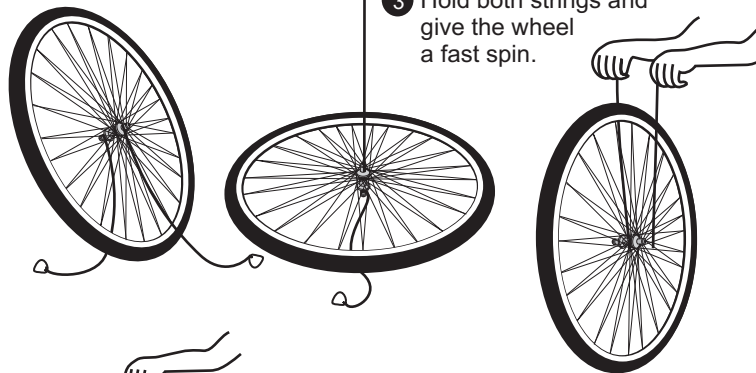




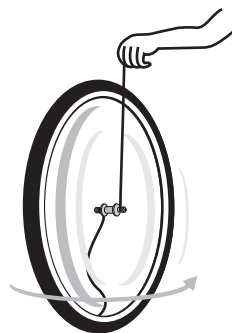
- 1 Tie two strong strings 80-cm long on both ends of the axle of a cycle wheel. Tie knots on their ends.

- 2 On hanging the wheel by one string it will lie horizontal.

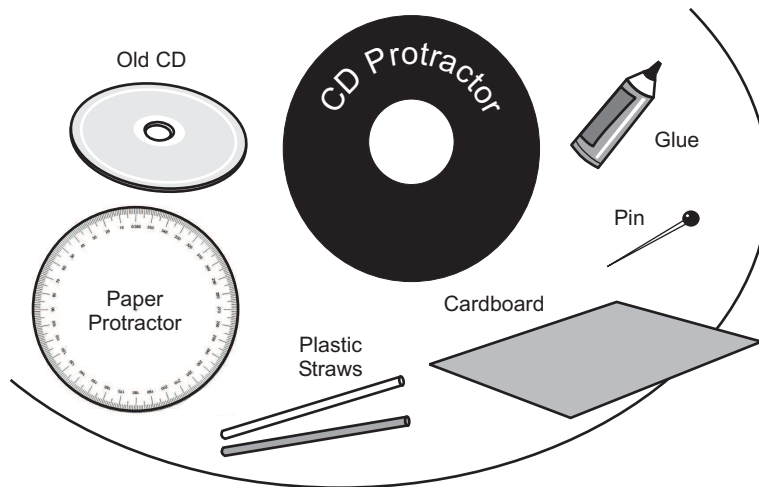
- 3 Hold both strings and give the wheel a fast spin.



- 4 Once the wheel starts spinning drop the left hand string. The wheel will not fall down! Instead, while spinning it will start rotating in the clockwise direction.



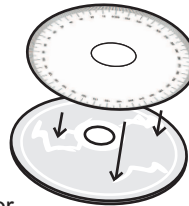
However, if you drop the right hand string while the wheel is spinning then it will rotate slowly in the anti-clockwise direction.



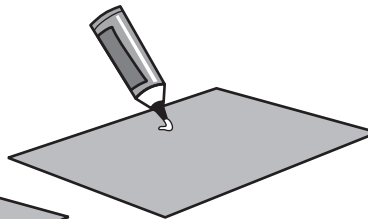
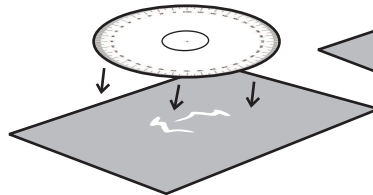
- 1 Apply rubber glue on top of an old CD.



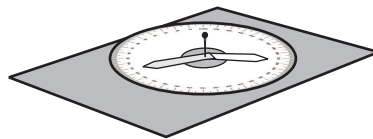
- 2 Stick the printout of a paper protractor on this CD. The protractor will indicate angles from 0 to 360-degrees.

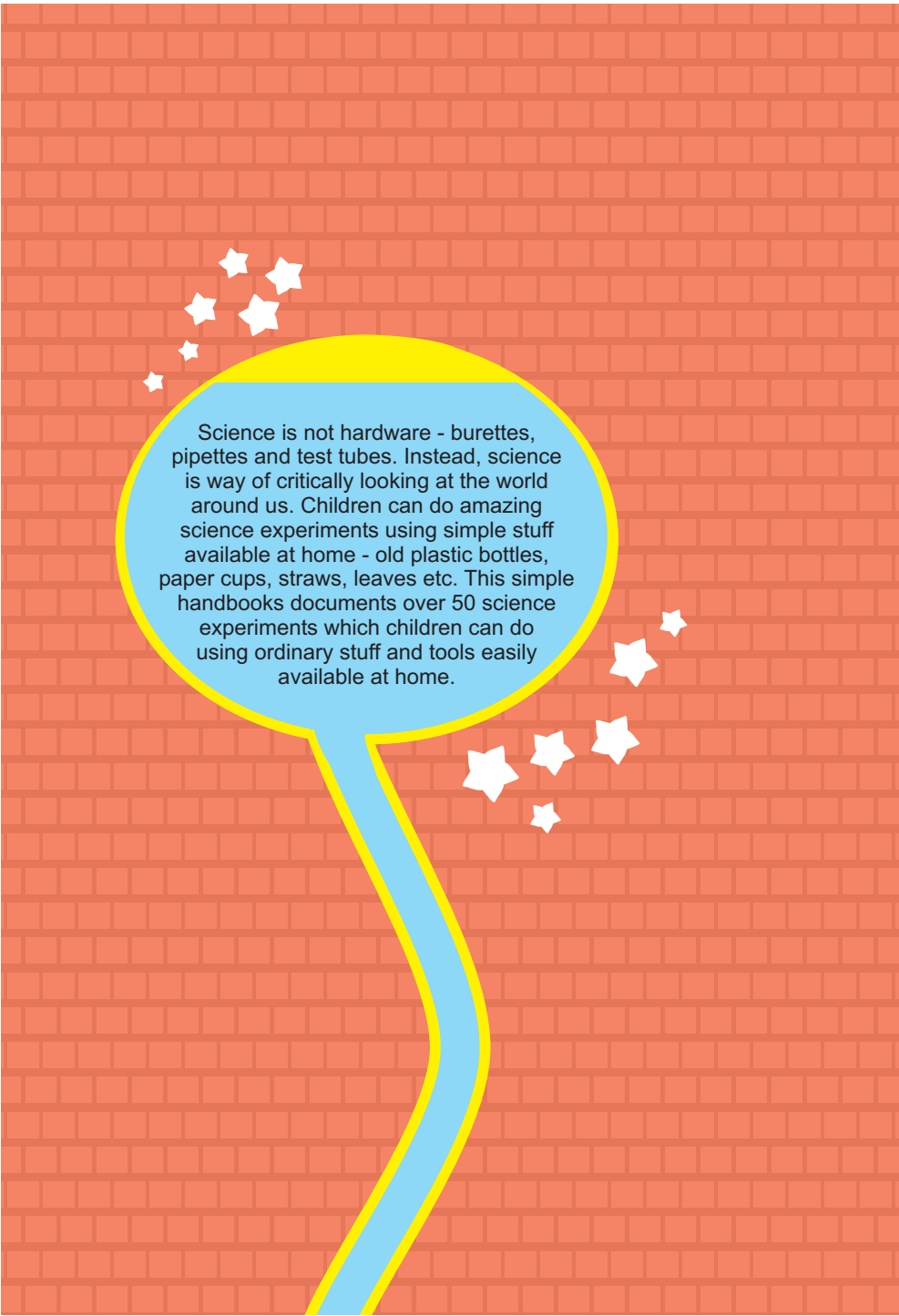


- 3 Apply glue on a thick cardboard and stick the CD protractor on it.



- 4 Cut points in two short straws. Pivot them in the center of the protractor with a paper pin. Use these straw pointers to measure angles.





Science is not hardware - burettes, pipettes and test tubes. Instead, science is way of critically looking at the world around us. Children can do amazing science experiments using simple stuff available at home - old plastic bottles, paper cups, straws, leaves etc. This simple handbooks documents over 50 science experiments which children can do using ordinary stuff and tools easily available at home.